İSTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY

GREEN BUILDING RATING SYSTEMS:
An Assessment for Turkey and the case of Erzurum Shopping Center – the first BREEAM Certified Building of Turkey

M.Sc. Thesis by
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Department : Inter Disiplinary

Programme : Real Estate Development

Thesis Supervisor: Assist. Prof. Dr. Özhan ERTEKİN

JUNE 2010

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Date of submission : 07 May 2010
Date of defence examination: 07 June 2010

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JUNE 2010

İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

YEŞİL BİNA DERECELENDİRME SİSTEMLERİ:
Türkiye Üzerine Değerlendirmeler ve Erzurum Alışveriş Merkezi Örneği – Türkiye'nin ilk BREEAM Sertifikalı Yeşil Binası

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Tezin Enstitüye Verildiği Tarih : 07 Mayıs 2010
Tezin Savunulduğu Tarih : 07 Haziran 2010

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HAZİRAN 2010

FOREWORD

First of all, I would like to express my deep appreciation and thanks for my advisor Assist. Prof. Dr. Özhan ERTEKİN for his support.

And, I would like to thank Caner DEMİR from ECOFYS(Turkey) for his precious time, endless help and his concern during my research.

I am also grateful to Emrah ÇOBAN and İlker AYDIN from REDEVCO (Turkey) and, Derk WELLING; Manager of Sustainability, Energy & Environment in REDEVCO (the Netherlands) .

And, A heartfelt thank to my family, Firuze and my friends, especially Eren KÜRKÇÜOĞLU who have motivated me to continue in completion of these thesis.

Special thanks goes to my mother, Hüsniye GÜVEN who has been positive, supportive and encouraging throughout my studies and who always gives me hope for success and happiness in my life as my greatest inspiration.

May, 2010 **Meltem TÜRKER**

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ABBREVATIONS

ASHRAE	**:**	American Society of Heating, Refrigerating, Air Conditioning Engineers
BMS	**:**	Building Management Service
BREEAM	**:**	The Building Research Establishment Environmental Assessment Method
CASBEE	**:**	Comprehensive Assessment System Building Environmental
CCHP	**:**	Combined Cooling Heating and Power
CHP	**:**	Central Heating Power
CIBSE	**:**	The Chartered Institution of Building Services Engineers
CO_2	**:**	Carbon Dioxide
EIA	**:**	Efficiency Energy Information Administration
EPA	**:**	Environmental Protection Agency
GHGs	**:**	Green House Gas Emissions
GOBAS	**:**	Green Olympic Building Assessment System
GWP		Global Warming Potential
HIA	**:**	Health Information Administration
HVAC	**:**	Heating Ventilation and Air – Conditioning
LCA	**:**	Lifecycle Cost Analysis
LEED	**:**	Leadership in Energy and Environmental Design
LTHW	**:**	Low Temperature Hot Water
LZCS	**:**	Liquid Zone Control System
METU	**:**	Middle East Technical University
NABERS	**:**	National Australian Built Environment Rating System
NOx	**:**	Nitrogen Oxide
PV	**:**	Photo Voltaic
UK	**:**	United States of America
UKAS	**:**	United Kingdom Accreditation Service
USA	**:**	United States of America
USGBC	**:**	United States Green Building Council
UNEP	**:**	United Nation Environment Programme
WGBC	**:**	World Green Building Council

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GREEN BUILDING RATING SYSTEMS : An Assessment for Turkey and the case of Erzurum Shopping Center – the first BREEAM Certified Building of Turkey

SUMMARY

Our developing world has caused many to be concerned over sustaining our resources, environment, and way of life and increased at an alarming rate over the past two decades, especially in the built environment.

The need for sustainable development in the real estate sector has become significant mostly due to the major resource consumption and contamination buildings generate. Green buildings have the potential to minimize this negative impact on the environment and offer business and occupant health related benefits for real estate developers as a way to move forward.

Recently, we know that it is urgent to understand the relationship between business and sustainability. A variety of green building rating systems have been developed around the world to reduce negative impacts of buildings. Many countries have either already adopted the green building guidelines or are in the process of adopting them.

So, thesis study's main topic is enhancing awareness and knowledge on green building and analyzing the green building rating systems around the world to point out the future directions of green building movement in Turkey. It also focuses on green building rating systems from a global perspective and a comparison of two major adoptable green rating system BREEAM and LEED to determine their sustainability characteristics can help generate the first steps of a national green building rating system in Turkey. And it is supported with a case study of Turkey's first BREEAM certified building, Erzurum Shopping Center to determine the requirements and the pathways for adopting a national green building rating system.

YEŞİL BİNA DERECELENDİRME SİSTEMLERİ : Türkiye Üzerine Değerlendirmeler ve Erzurum Alışveriş Merkezi Örneği – Türkiye'nin ilk BREEAM Sertifikalı Yeşil Binası

ÖZET

Gelişen dünyamızda doğal kaynakların, çevre ve yaşam şekillerimizin sürdürülebilirliği endişe verici boyutlara ulaşmakla birlikte; çevre yapılaşmalar özellikle son yirmi yıl içerisinde alarm veren noktalara dayanmıştır.

Emlak ve inşaat sektöründe sürdürülebilir geliştirmeye olan ihtiyaç, binaların yarattığı kaynak tüketimi ve kirlilikle beraber daha belirgin bir hale gelmiştir.

Son zamanlarda iş dünyası ve sürdürülebilirlik arasında ivedi bir ilişki oluşmuştur. Dünya genelinde binaların yarattığı olumsuz etkileri azaltmaya yönelik çeşitli yeşil bina derecelendirme sistemleri geliştirilmiştir. Bir çok ülke yeşil bina rehberliğinde gerekli adaptasyonları yapmış ya da yapma sürecine girmiştir.

Özetle; tezin ana konusu, yeşil binalara ilişkin olarak farkındalık ve bilginin arttırılması ile birlikte; Türkiye'nin geleceğe ilişkin atacağı adımlar konusunda genel çıkarım ve yönlendirmeler oluşturma amaçlı, dünyadaki yeşil bina derecelendirme sistemlerinin analizini yapmaktır.

Yeşil bina derecelendirme sistemlerine global perspektifte bir bakış açısı sunmakla birlikte, aynı zamanda dünya genelinde en yaygın kullanılan iki sistem olan LEED ve BREEAM üzerine yoğunlaşarak, sürdürülebilirlik kriterlerinin tanımlanması ve karşılaştırılması yoluyla, Türkiye için oluşturulması önerilen ulusal bir yeşil bina derecelendirme sisteminin ilk adımları hususunda yardımcı genel bir çalışma yapılmaktadır.

Son olarak, Türkiye'nin ilk BREEAM sertifikalı yeşil binası olan Erzurum Alışveriş Merkezi örneği ile yapılması gereken çalışmalara yönelik genel yöntem ve gereklilikler desteklenmektedir.

1. INTRODUCTION

Our developing world has caused many to be concerned over sustaining our resources, environment, and way of life. We face an escalating population growth and the concern over having enough resources for development to meet our needs in the present and that of future generations. Our society has created a business production paradigm that needs more planning to preserve our natural capital, and to minimize waste in the process of development. Although growth is important, it must be done efficiently and with the mindset that many of our resources are finished. The consumption of material and energy in the world has increased at an alarming rate over the past two decades, especially in the built environment (Feltes, 2007).

Modern capitalism has pursued real estate development and growth without enough forward thinking to sustain our natural environment, until recently. Fifty to a hundred years ago we did not feel it was urgent to understand the relationship between business and a healthy environment. But, in the new millennium, we know that it is imperative to alter wasteful development and work toward a more restorative process that not only helps to preserve our valuable resources, but improves the quality of life for all of humanity.

The majority of real estate developers yet discover the green building in favor of development as usual. More and more users from office tenants to homebuyers are demanding buildings that meet basic sustainable standards. More and more cities, states, and national governments are mandating basic green standards. Real estate markets now are demanding green buildings and rewarding with higher rents and sales prices.

At the same time, there has been an effort by governments and business enterprise over the years to move toward a more balanced way of growth that is sustainable. Although it leaves much room for interpretation, it has been generally embraced by many international organizations, governments and business enterprises.

1.1 The Aim of Study

The need for sustainable development in the real estate sector has become significant in the last decade mostly due to the major resource consumption and contamination buildings generate. Green buildings have the potential to minimize this negative impact on the environment and offer business and occupant health related benefits for real estate developers as a way to move forward.

Worldwide, a variety of green building rating systems have been developed around environmental and energy impacts of buildings. Many countries have either already adopted the green building guidelines or are in the process of adopting them.

Turkey is one of the developing countries should adopt or develop a green rating system as a national strategies. Two of the major aims of this thesis is analyzing the green building and the green building rating systems around the world to point out the future directions of green building movement in Turkey.

It is written in advocacy of sustainability which is seen as a fundamental requirement of our national strategy, and it concludes to determine the requirements and the pathways for adopting a national green building rating system.

This thesis will also encourage and may guide the stakeholders involve in green building seriously and take part in adopting a green building rating system as nationally. It additionally also enhance awareness and knowledge of real estate developers and other concerned parties or authorities on green building.

1.2 Background

Green building involves the consideration of many issues, including land use, site impacts, indoor environment, energy and water use, lifecycle impacts of building materials, and solid waste. In this thesis, the concept, benefits, and history of green building are discussed.

As with any voluntary and independent rating system, it is important to disentangle the market-based and competitive nature of the systems from the roles these systems may eventually play in the development of public policy or a national standard.

Thesis focuses on green building rating systems from a global perspective and a comparison of two major adoptable green rating system BREEAM and LEED to determine their sustainability characteristics. The overlaps, similarities and differences in them can help generate the first steps of a green building rating system in Turkey (Figure 2.1 : Flowchart of the thesis).

Thesis presents the background of green building movement in Turkey its components parts and addresses a case study of Turkey's first BREEAM certified building, Erzurum Shopping Center to determine the requirements and the pathways for adopting a national green building rating system.

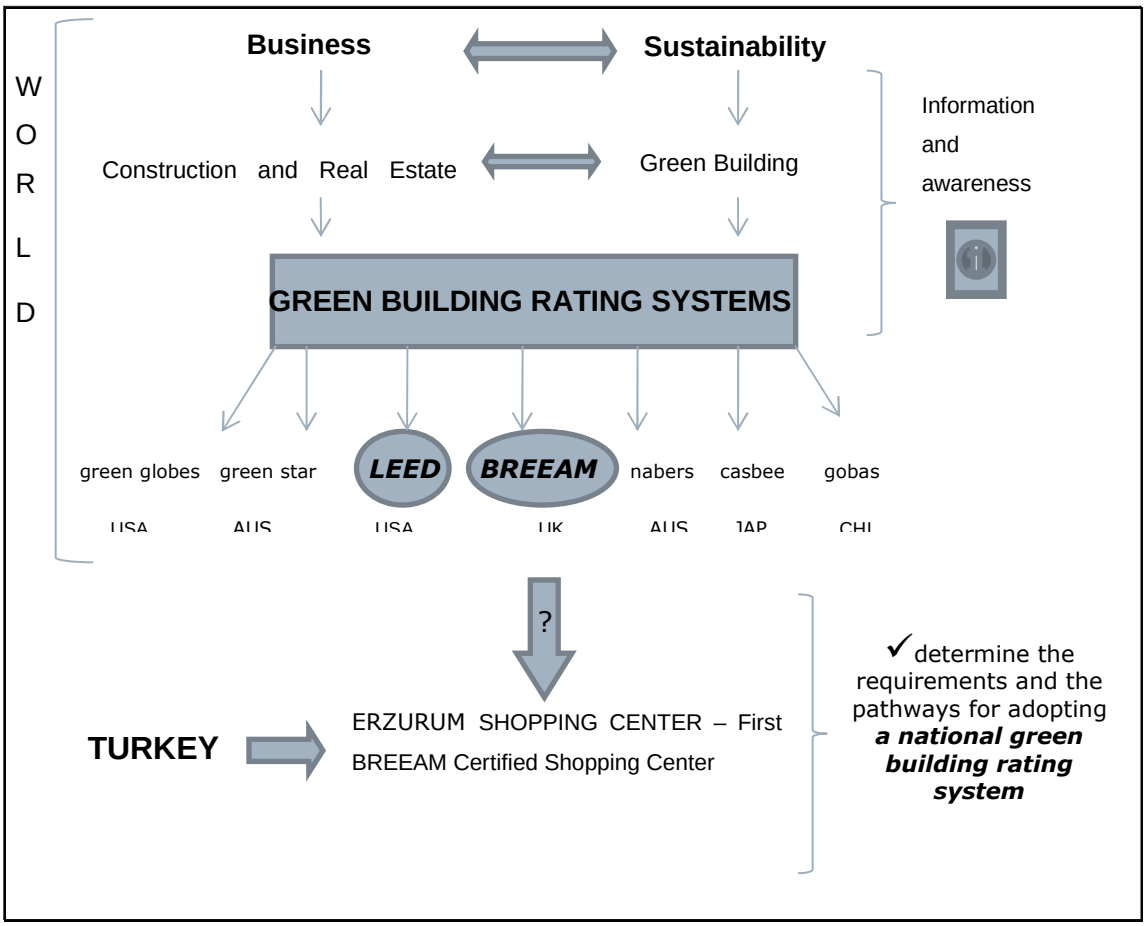

Figure 2.1 : Flowchart of the thesis

1.3 Methodology

The aim of the work is described in detail in the first section. In the section two which is named as green building, a general definition of sustainability, sustainable development and green building are given so that the subject is observed in a

complete way and is understood clearly. Green building is analyzed in details with a related literature review. The necessity and the benefits of it are discussed.

In the section three, green building standards which is used to develop green building rating systems and most known green building rating systems around the world are analyzed to have a general opinion about the rating systems and their assessments.

And also, most widely international adoptable system LEED and BREEAM are analyzed in a closer view. The comparison systems are discussed to determine the way of adoption a national green building rating system especially for Turkey.

In the fourth section, there has been made an approach to Turkey and green building movement in Turkey with its components to understand the current situation.

And in the fifth section, an analysis of Turkey's first BREEAM certified building, Erzurum Shopping Center is given as a case study to determine the requirements can help generate the first steps in adoption of a national green building rating system.

In section six, it concludes with the recommendations which also comes from the analysis of Erzurum Shopping Center.

2. GREEN BUILDING

2.1 Defining the Relation Between Sustainability and Green Building

Over the past two decades, the green building movement has evolved tremendously. Green Building, as a concept, has become much more broad and inclusive, as more people recognize the connections between the natural and built environments, and between the economic, environmental, and social effects of standard building practices.

Sustainability and sustainable development is also very important to understand the meaning of green building in an holistic approach. Definitions of sustainability are varied and possibly need to be framed within a specific context to hold specific meaning, although there is broad agreement that it is about balancing and integrating environmental, social and economic elements.

There is no unified consensus on what it means to be sustainable in terms of building and construction and human settlements. Many definitions have been suggested but it may require an understanding of all the elements of a comprehensive green building rating systems to fully appreciate all the aspects of green building (Cole and Larsson 2002).

2.1.1 Sustainability

Sustainability is the foundational principle underlying various efforts to ensure a decent quality of life for future generations. The Bruntland Report, more properly known as “Our Common Future” (1987), defines sustainability and sustainable development as “ **meeting the needs of the present without compromising the ability of future generations to meet their needs**. ” This classic definition implies that the environment and the quality of human life are as important as economic performance and suggests that human, natural, and economic systems are interdependent.

It also implies intergenerational justice raises the question of how far into the future we should consider the impacts of our actions. Although no clear answer to this important question is readily apparent, the Native American philosophy of thinking seven generations, or 200 years, into the future is instructive. If in two centuries few con-temporary buildings will be standing, we must ask whether our present stock of materials will provide recyclable resources for future generations or saddle them with enormous and difficult waste disposal problems. It is this question, originating in the philosophy of sustainability, that marks the fork in the road of our current industrial processes. Those on the path of " business as usual " will view the environment as an infinite source of materials and energy and a repository for waste. In contrast, those on the more ethical " road less traveled " will regard the quality of life of our descendants and question whether we are permanently stealing, versus temporarily borrowing, the environmental capital of future generations. At the philosophical core of the green building movement is the decision to embark on the latter path (Kibert, 2008).

2.1.2 Sustainable Development

The awareness about sustainable development is growing around the globe last few decades. Ever since the Rio Summit in 1992 when the Agenda 21 was formulated, the concept of Sustainability and Sustainable Development has slowly but surely penetrated the discussions on the future direction and progress of all sector of our society (Luc Bourdeau, 1999).

Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations. The term was used by the Brundtland Commission which coined what has become the most often-quoted definition of sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing humanity. As early as the 1970s "sustainability" was employed to describe an economy "in equilibrium with basic ecological support systems". Ecologists have pointed to The Limits to Growth, and

presented the alternative of a “steady state economy” in order to address environmental concerns.

The field of sustainable development can be conceptually broken into three constituent parts: environmental sustainability, economic sustainability and sociopolitical sustainability (Figure 2.2 and Figure 2.3).

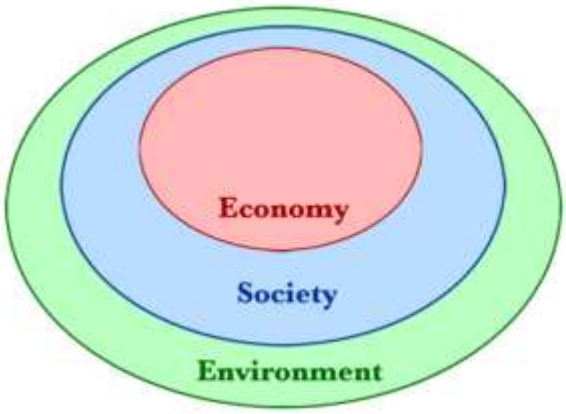

Figure 2.2 : Sustainable Development : A representation of sustainability showing how both economy and society are constrained by environmental limits, 2003 (source: Url-1)

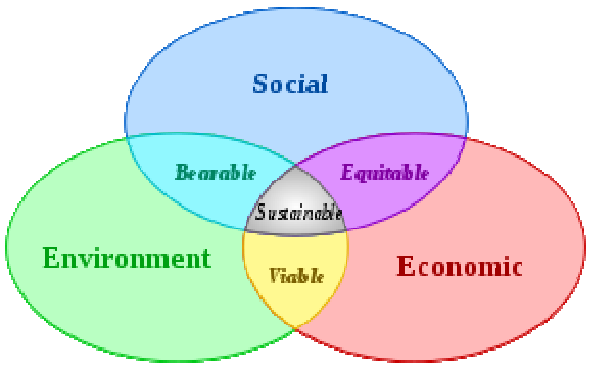

Figure 2.3 : Sustainable Development : Scheme of sustainable development: at the confluence of three constituent parts, 2006 (source : Url-1)

Sustainable development is not just about environmental protection, although this is important. It is also concerned with the quality of life, the range and distribution of resources and benefits, the interactions between environment and development and provision for the future. This is where the integration of economic, social, and environmental dimensions of development take placed (Figure 2.1). In effect, it seeks to reconcile the socio-economic aspirations; to ensure that development is within the carrying capacity of the environment (Nok, 2008).

Chaharbaghi and Willis (1999) described about the ideal world where people in it live in peace and secure, breath clean air, drink clean water and eat uncontaminated food. It is a perfect world where people really have enjoyable life, growing in healthy environment and the children have educated life. In fact, the real world is far from the ideal world. There is a growing concern about the long term future, the resources or the planet , the environment and high level of poverty, which are linked with the spread of disease, social unrest, population growth and environment degradation. By the implementation of the sustainable development, helps to minimize the bridge of gap between the real world and the ideal world.

As a conclusion, sustainable development mainly focusing into three different aspects; economic, social and environment, in order to fulfilling human needs for present the future generation, by involving many parties to reduce gaps between the real world and the ideal world.

2.1.3 Related Literature Review of Green Building

Green building practices are not new phenomena. A handful of buildings integrating environmental design aspects were erected as early as the late 19th and early 20th centuries**.** After World War II, a stern belief in technical progress and the abundance of cheap fossil fuels resulted in a building style with little regard for energy efficiency or other ecological aspects.

A unified green building movement did not begin to emerge until the 1970s, when design and building practices first became a focus of environmental advocates. The first attempts at introducing environmental considerations into the design process were characterized by hostility towards the design community and by a focus on developing countries (Madge 1993).

In the 1980s, the issue reemerged under the labels of sustainable development (Rees 1989) and sustainable design (St. John 1992) and this time, it proved more successful. During the last decade, a proliferation of publications on sustainable design and architecture have appeared. Some of these works focus on outlining target objectives, without quantifying their costs and benefits or going into much detail about strategies to attain them.

For instance, Hawken, Lovins and Lovins (1999) discuss a number of green buildings, and then proceed to propose integrative design as a solution to ecological

shortcomings, with retrofit insulation and installation of energy efficient appliances as second best solution.

The built environment uses large amounts of scarce resources and contributes significantly to the production of global emissions and waste (Edwards, 2002 and Chege, 2004). For instance, construction and post construction activities consume 50% of all resources globally, 40% of global water usage is used for sanitation and other user within buildings and 60% of agricultural land (lost to farming) is used for construction activities (Edwards, 2002). This negatively affects the health of people and the state of natural environment (Forsberg and von Malmborg, 2004).

Since the detrimental effects of construction practices on the natural environment were highlighted, the performance of the buildings has become a major concern for occupants and built environment professionals (Crawley and Aho, 1999; Ding, 2008; Cooper, 1999; Kohler, 1999; and Finnveden and Momberg, 2005).

In response to this concern of reducing environmental impact of the design and operation of buildings, many researchers have developed methods for measuring environmental performance o buildings with the intention of creating a sustainable built environment (Crawley and Aho, 1999; Blom, 2004).

The British Research Establishment Environmental Assessment Methodology (BREEAM) developed in 1990 by the British Research Establishment was the “first real attempt to establish a comprehensive means simultaneously assessing a broad range of environmental considerations in building” (Haapio, 2008).

Subsequent to this numerous tools have been developed or adapted from existing assessment tools (Cole, 2005; Haapio, 2008). Green building rating tools are also referred to (but not limited to) as green building rating systems (Yudelson, 2008), building environmental assessment tools/methods/systems (Gomes, 2007; Cole, 1998), and environmental assessment tools (Blom, 2004).

These tools enhance the environmental awareness of building practices and provide fundamental direction for the building industry to move toward environmental protection and the achievement of sustainability (Ding, 2008). They provide a way of showing that a building has been successful in meeting an expected level of performance in various declared criteria (Cole, 2005).

Their adoption and promotion has had a major contribution to creating a market demand for green buildings and has significantly shifted the public's awareness and perceptions of what building quality is (Cole,2005). This is confirmed by the increasing number of people demanding information on environmental aspects of buildings, such as whether or not a building is good for their health or if it fits into a sustainable society (Carlson & Lundgren, 2002).

Most of the early green building assessments were pursued by public agencies, but today, private demand for green buildings is catching on, too. Yudelson (2004) forecasts green building growth rates in the double digits until 2007. Despite this rapid growth and an estimated value of $ 7.4 billion in 2005, green building still remains a niche market, with only 2% market share in 2005 (NBN 2006).

The existence of market barriers for green building is discussed in a recent string of publications concerned with the costs and benefits of ecological construction. The intent of these publications is to dispel doubts about the net costs and benefits of green building. Adding ecological aspects to a building is often believed to lead to higher construction costs and lower attractiveness for the investor, while any benefits are a public good. If the business case for green building cannot be proven, there is little incentive for businesses to invest in it (Thompson 2003). Several authors have set out to demonstrate the net benefits of green buildings. Yates (2001) sees many economic advantages: Capital costs are not higher for many green construction elements and even where upfront costs are more elevated, they can often be offset by decreased operational costs.

Indeed, green building is being recognized increasingly as a means to managing risks. Improved construction practices associated with green design have been linked to some insurance companies providing lower premiums to owners of green buildings. Roodman and Lenssen (1995) discuss evidence that real estate values for green buildings appreciate faster than those of conventional buildings. They also point to shorter resale and release times, combined with longer tenant occupancy terms.

Nevertheless, green building is not seen as being inevitably profitable. Matthiessen and Morris (2004) find that while overall cost savings are possible in green building, they depend on factors such as climate, topography, timing, credit synergies and local building standards.

Less visible benefits of green building are also garnering interest. For instance, Fisk (2000) seeks to establish a link between indoor environmental quality on the one hand and higher productivity and better health on the other hand. He estimates that in the United States, increased worker performance alone could amount to up to $ 160 billion in efficiency gains. Another $ 48 billion could be saved thanks to fewer occurrence of asthma, allergies and sick building syndrome.

2.2 Green Building

Green building (also known as green construction or sustainable building) is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation

According to the U.S. Environmental Protection Agency (2009), Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from sitting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

The California Integrated Waste Management Board defines a green building as, “A green building, also known as a sustainable building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Green buildings are designed to meet certain objectives such as protecting occupant

health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment" (2010).

The Massachusetts Technology Collaborative Renewable Trust, defines a green building as, "a building that has been constructed or renovated to incorporate design techniques, technologies, and materials that minimize its overall environmental impacts" (2010).

Jerry Yudelson, in "The Green Building Revolution," describes a green building as, "a high-performance property that considers and reduces its impact on the environment and human health" (2008).

The definitions of a green building will sometimes include a description of a high-performance building. A high-performance building while similar to a green building specifically aims to be energy efficient. Others refer to some of the high-tech aspects of it as "high performance" or "smart" building. Sustainable building is often referred to as **"green"** or "environmentally sound" building. However in this thesis, it will be referred as **"green"**, mainly because that has become the most widely accepted, catch-all term.

In thesis, **"Green Building"** is defined as the design and construction of buildings using methods and materials that are resource efficient and that will not compromise the health of the environment or the associated health and well-being of the building's occupants, construction workers, the general public, or future generations. Green building involves the consideration of many issues, including land use, site impacts, indoor environment, energy and water use, lifecycle impacts of building materials, and solid waste.

2.2.1 Necessity of Green Building

Construction industries play a major role to achieve a sustainable development. Construction industries involved with built environment such as building, infrastructures and facility services.

The current main environmental issue of global warming holds particular importance to the building and real estate & construction sector. According to the United Nation Environment Program (UNEP, 2007); the combined energy use of building and construction amounts to 39% of global greenhouse gas emissions (GHG) and

statistics show that green building is the most cost-effective approach to CO_2 emissions (Figure 2.4).

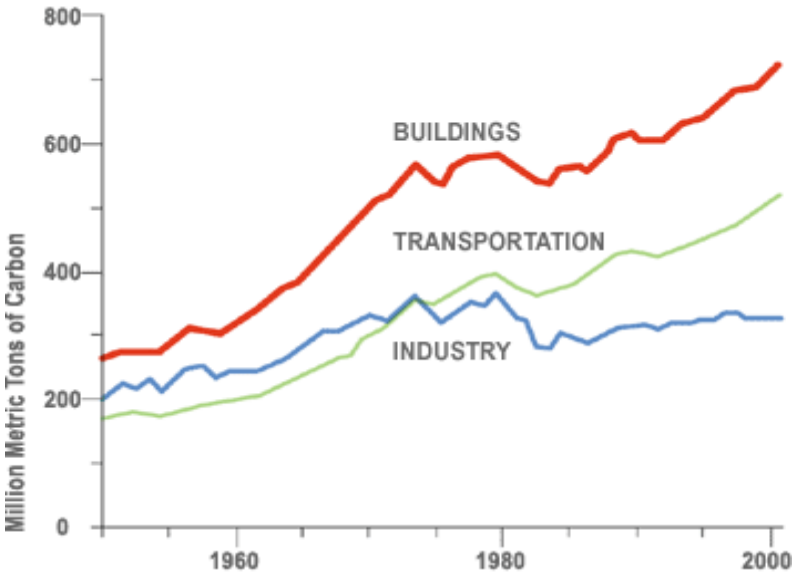

Figure 2.4 : Global CO_2 Emissions by sectors (source : USA Energy Information Administration – EIA , 2006)

Building and construction is import for sustainability for many reasons. It is linked to all other major sectors including mining, manufacturing, agriculture and transport. The sector also impacts on other environmental issues including resource depletion, pollution and waste at each stage through mining, production or manufacture, design and construction, operation and occupancy and deconstruction/demolition (Table 2.1).

Table 2.1: Impacts of Buildings on Resources (source : Url-2)

Primary Energy Use	**40%**
Electricity Consumption	**72%**
CO_2 Emissions	**39%**
Potable Water Consumption	**13.6%**

There are also the social issues that are impacted by building and construction like health and productivity. Economically, this sector has a profound influence on all

other sectors and is often used by governments as a measure of economic growth (HIA, 2002).

2.2.2 Benefits and Cost of Green Building

There are a number of environmental, social, and economic benefits to be reaped from building more sustainably (Table 2.2).

Table 2.2: Benefits of Green Building

ENVIRONMENTAL	✓ Enhance and protect ecosystems and biodiversity ✓ Improve air and water quality ✓ Reduce solid waste ✓ Conserve natural resources
ECONOMIC	✓ Reduce operating costs ✓ Enhance asset value and profits ✓ Improve employee productivity and satisfaction ✓ Optimize life – cycle economic performance
HEALTH AND COMMUNITY	✓ Improve air, thermal, and acoustic environments ✓ Enhance occupant comfort and health ✓ Minimize strain on local infrastructure ✓ Contribute to overall quality of life

- **Environmental Benefits :**

Environmental benefits of green building to our shared environment include; air and water quality protection, soil protection and flood prevention, solid waste reduction, energy and water conservation, climate stabilization, ozone layer protection, natural resource conservation, open space, habitat, and species/biodiversity protection.

Green building can reduce the impacts on resources as shown below (Table 2.3);

Table 2.3: Environmental Benefits of Green Building (source : Url-2)

Energy Use	**24% - 50%**
CO_2 Emissions	**33% - 39%**
Water Use	**40%**
Solid Waste	**70%**

People benefit from environmental improvements not only for health and aesthetic reasons, but also as tax payers. For example, reducing water, energy, and materials use and siting buildings close to public transportation reduces the demand for costly expansions of infrastructure like water treatment plants, utilities, landfills, and roads. On an even broader societal level, green building can enhance our national security by reducing our country's dependence on fossil fuel imports, for example.

- **Health and Community Benefits :**

  Green Building also improve health, comfort, productivity and performance of occupants and construction workers; and related savings for their employers. Improvements in a building's air quality and day-lighting can make for healthier and happier occupants.

  According to a study held by Lawrence Berkeley National Laboratory in 2002; significant associations exist between low ventilation levels and higher carbon dioxide concentrations, a common symptom in facilities, with sick building syndrome. And also, an experiment identifies a link between improved lighting design and a 27% reduction in the incidence of headaches (Aaras, 1998).

  Furthermore; researches by Heschong Mahone Group which were headlined 'Skylighting and Retail Sales: An Investigation into the Relationship Between Day-lighting and Human Performance' and 'Day-lighting in Schools: An Investigation into the Relationship Between Day-lighting and Human Performance' showed that firstly sales in stores with skylights were up to 40%

higher compared to similar stores without skylights and secondly students with the most day-lighting in their classrooms progressed 20% faster on math tests and 26% faster on reading tests in one year than those with less day-lighting (USGBC; 2009).

On the other hand, improvements in indoor environments are estimated to save $17-48 billion in total health gains and $20-160 billion in worker performance (Fisk, 2000).

- **Financial Cost and Benefits :**

There are proven financial benefits of green building (Table 2.4).

Table 2.4: Perceived Financial Benefits of Green Building (source : Url-2)

Operation Cost Decreasing	**8 - 9 %**
Building Value Increasing	**7.5 %**
Return on Investment Improves	**6.6 %**
Occupancy Ratio Increases	**3.5 %**
Rent Ratio Increasing	**3 %**

Green buildings are commonly perceived to be a lot more expensive than conventional buildings and often not worth the extra cost. In order to determine the cost of building green compared to conventional design, several dozen building representatives and developers were contacted to secure the cost of green buildings from across the United States compared to conventional designs for those same buildings (USGBC, 2009)

The average premium for these green buildings is slightly less than 2%, or $3-5/ft2, substantially lower than is commonly perceived. The majority of this cost is due to the increased architectural and engineering design time, modeling costs and time necessary to integrate sustainable building practices into projects (Kats, 2003).

Generally, the earlier green building features are incorporated into the design process, the lower the cost. Green Buildings provide financial benefits that

conventional buildings do not. These benefits include energy and water savings, reduced waste, improved indoor environmental quality, greater employee comfort/productivity, reduced employee health costs and lower operations and maintenance costs (Kats, 2003).

Lower construction costs, mainly through materials use reduction and savings on disposal costs because of recycling, as well by downsizing mechanical equipment and avoiding certain infrastructure extension fees. Of course, the initial expense of other green building measures may outweigh these savings, if measures are not selected and balanced carefully.

Lower operating costs, from energy and water savings. Energy efficiency investments, for example, almost always deliver a payback within one to five years: a very quick return on investment. Energy savings of up to 50% are not uncommon, according to Norman Willard of the U.S. Environmental Protection Agency; in some cases, energy consumption can be cut by as much as 80%. These savings can make a real difference.

One respondent attributed higher costs to some designers' attempt to make every single aspect of a project "green." On the whole, sustainable building practitioners tend to agree that project teams should select a package of strategies that make the most sense for that project's site and climate conditions, client priorities and budget, and design programming, rather than try to do a little of everything.

And also, it is important for owners and real estate developers to remember that the cheapest development is not necessarily the most profitable. Putting environmentally-sensitive features into a building enhances its quality and adds value, just as putting in typical amenities does.

Lower operating costs and environmental features make buildings more attractive to potential buyers. Overall, building rental rates and tenant retention have been shown to be higher in green projects.

2.3 Evaluation

Based on the literature review, a green building is one whose structure is designed, built, and operated in such a way that the negative impact to human health and the

environment will be reduced. This includes resources used during construction and operation of the building once it is completed.

As a conclusion, green building is the best way to move forward in construction sector with its multiple benefits as a real estate developer. It has shown that there are benefits from green building to the occupants and users, to community and society, and also to the environment. Specifically it shows that green building does not need to be more costly than traditional building, and that there are direct financial benefits in terms of reduced operating costs, improved health and higher productivity

At this point, the lack of a global definition of what truly constitutes a green building, and the lack of a global valuation system to measure accurately a green building's performance are compounding problems.

However, green rating systems and their assessments, which is based on green building standards, are one of the voluntary solutions to define the way. In the next section, most known green building rating systems are detailed.

3. GREEN BUILDING RATING SYSTEMS

3.1 Introduction

The main movers and shakers behind the development and promulgation of green building standards and green building rating systems are the green building councils of individual countries and the World Green Building Council (WGBC) whose members are green building councils representing countries such as Australia, Brazil, Canada, India, Japan, Mexico, New Zealand, Spain, Taiwan, the United Arab Emirates, the United Kingdom, and the United States.

National governments also have played a role in creating green building standards, as have some green building and energy-efficient building organizations (Lockwood, 2007). Before analyzing the green building rating systems, it is better to give some focus on the standards behind.

3.2 Green Building Standards

Green Building Standards are guidelines and tools to consider for developing green rating systems or adopting them. It may require an understanding of green building standards to fully appreciate the green rating systems. Some of the most widely used standards are given below:

- **ASHRAE Standards:**

  ASHRAE, **American Society of Heating, Refrigerating, and Air-Conditioning** (HVAC&R**) Engineers** founded in 1894, is an international organization of 51,000 persons. ASHRAE fulfills its mission of advancing heating, ventilation, air conditioning and refrigeration to serve humanity and promote a sustainable world through research, standards writing, publishing and continuing education. ASHRAE develops and also publishes a well recognized series of standards and guidelines relating to **HVAC** systems and issues. These standards are often referenced in building codes, and are considered useful standards for use by consulting engineers, mechanical contractors, architects, and

government agencies. ASHRAE does not write rating standards unless a suitable rating standard will not otherwise be available.

One of the most useful standards of ASHRAE in international area is **Standard 189.1**, which defines the minimum requirements for high performance, green buildings, was developed by ASHRAE, the U.S. Green Building Council **(**USGBC) and the Illuminating Engineering Society (IES). Discussions are underway with the International Standard 189.1, which defines the minimum requirements for high performance, green buildings, was developed by ASHRAE, the U.S. Green Building Council (USGBC) and the Illuminating Engineering Society (IES). Discussions are also underway with the International resources. It creates the foundation for all of these to come together to make a productive, safe and efficient building that is truly high performing standards for both its members and others professionally concerned with refrigeration processes and the design and maintenance of indoor environments.

- **CIBSE Standards:**

CIBSE, The Chartered Institution of Building Services Engineers received its Royal Charter in 1976. CIBSE is the standard setter and authority on building services engineering. It publishes Guidance and Codes which are internationally recognized as authoritative, and sets the criteria for best practice in the profession. The Institution speaks for the profession and so is consulted by government on matters relating to construction, engineering and sustainability. It is represented on major bodies and organizations which govern construction and engineering occupations in the UK, Europe and worldwide.

However, these standards can be used as internationally in most of green building rating systems, many countries have their own standards as national strategies.

Besides ASHRAE and CIBSE; European Union has Green Building Program which focuses on energy – efficiency for example; and also countries like China, Japan and Australia has their own green building standards as national strategies accordingly to their green building rating systems.

But; in the scope of this thesis, it will be analyzed in more detailed as the green building rating systems.

3.3 General View to Green Building Rating Systems Around the World

Green building rating systems, which define what constitutes a green building and set the criteria for developing and often operating a green building, can now be found throughout the European Union, North America, Australia, and Asia, and are beginning to appear in the Middle East.

In 2006, there were over 34 green building rating systems or environmental assessment tools available to the marketplace, and the number is likely to grow. In the scope of thesis, here are the seven primary developing players in green building rating systems:

- **BREEAM** (Building Research Establishment's Environmental Assessment Method)
- **LEED** (Leadership in Energy and Environmental Design)
- **Green Globes**
- **Green Star**
- **NABERS** (National Australian Built Environment Rating System)
- **CASBEE** (Comprehensive Assessment System for Building Environmental Efficiency)
- **GOBAS** (China's Green Olympic Building Assessment System)

Each of these in some part was developed to promote environmentally responsible design, construction, and operating approaches as well as transform the built environment and marketplace as we traditionally understand it. All of them offer some form of score so that the high-performance claims of projects can be compared openly, at least within each system.

In the following sections, it is provided that review of the five leading systems based on study of documents available at the respective organizations' websites, rating system guides, and tools developed for using the systems

3.3.1 BREEAM (United Kingdom)

The U.K.'s real estate industry was faced with growing public awareness of environmental issues, increasing market demand for green buildings, and a number of developers who claimed that they had constructed green buildings.

The real estate industry wanted a reliable benchmark, that would both guide its green building efforts and remove false green claims from the marketplace.

In 1990, the United Kingdom became the first country to launch a green building standard: BREEAM—the Building Research Establishment Environmental Assessment Method. Revised in 2000, and expanded and updated annually since then, BREEAM assesses the environmental performance of new and existing buildings based on land use, energy use, water, building materials, occupant health and well-being, transport, pollution, ecology, and management. BREEAM was created, not by a green building council or an environmental organization, but by a government agency—the Building Research Establishment—at the request of the real estate industry.

Figure 3.1 : Rogers' Welsh Assembly building , Cardiff; biomass-powered and Breeam-rated "excellent", reached the 2006 Stirling shortlist (Source: Url-3)

BREEAM currently has green building standards for a wide variety of buildings, from offices to residential, industrial, and retail buildings; schools; courthouses; and even prisons (Figure 3.1).

Having served as the foundation for many green building standards around the world, BREEAM continues to lead the way with the recent introduction of BREEAM International, which is intended to guide and adapt green construction to varied conditions outside the U.K.

3.3.2 LEED (United States of America)

In 2000, the U.S. Green Building Council (USGBC) released its LEED (Leadership in Energy and Environmental Design) evaluation and rating program, which was based on the BREEAM standard. LEED evaluates site sustainability, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design process within a wide variety of building programs: new construction, major renovation projects, existing building operations, commercial interior (tenant improvement) projects, and core and shell projects. The USGBC recently initiated two pilot programs; LEED for Homes and LEED Neighborhood Development. The USGBC also is developing LEED Retail and LEED for Schools standards.

Figure 3.2 : First LEED Parking Garage: Santa Monica Civic Center, California U.S.A (source: Url-4)

As of January 2007, 22 states, and 74 municipalities, towns, and counties had adopted some level of LEED criteria for their new and renovating public facilities. Dozens of LEED-rated buildings have also been constructed in other countries, including Brazil, China, Côte D'Ivoire, Guatemala, India, Italy, Japan, Mexico, and Spain (usgbc.com).

As many as 824 buildings had received LEED ratings as of January and 6,415 new projects had registered for a LEED rating.

Despite its growing influence, LEED has come in for its share of criticism. The rating application process, for example, is considered too complex and expensive for many building owners. In some cases, the LEED criteria are too narrow in scope. Projects in major cities like New York and San Francisco, for example, lose many opportunities to gain site-related points, because LEED does not take into account that it has always been more difficult to construct buildings in major urban centers than in suburban areas.

In addition, points awarded under the LEED standard often do not reflect the time, cost, and effort given to a green component, which inadvertently encourages architects and developers to pursue LEED points, rather than a greener building.

The USGBC, however, has been acting steadily to improve LEED. The organization is developing a certification process for building in volume for both commercial and residential buildings to help mass production builders and developers earn LEED ratings for their projects at a significantly reduced cost. It is also adding lifecycle cost analysis (LCA) geographic-specific criteria to future versions of LEED.

3.3.3 Green Globes (United States of America)

Although LEED dominates in the United States, it is not the only American green building standard. Green Globes, for example, is a BREEAM-based green building standard that covers project management (policies and practices), site, energy, water, resources/building materials and solid waste, emissions and effluents, and indoor environment. Launched in 2004 by the Green Building Initiative (a nonprofit network of building industry companies), Green Globes still has fewer than a dozen rated buildings in the United States, but it did influence the USGBC to adopt LCA (Lifecycle Cost Analysis) in future versions of LEED.

Figure 3.3 : University of Arkansas Apartment Building, the first apartment to be Green Globes certified; U.S.A (source: Url-5)

3.3.4 Green Star (Australia)

The Green Building Council of Australia, founded in 2002, synthesized BREEAM, LEED, and other environmental standards into a Green Star rating system that is specific to the Australian environment and market. Initiated in 2004, the Green Star standard covers management, indoor environment quality, energy, transport, water, materials, land use, site selection, ecology, and emissions. Unlike LEED and many other green building standards, Green Star gives extra weight to categories that respond to a project's geographical location and climate.

Currently, Green Star covers new and existing offices. Green Star standards are being developed for convention and exhibition centers, retail shopping centers, residential buildings, health care facilities, and schools and universities.

In 2005, the Australian Green Star program's first six-star rating was awarded to Melbourne's Council House 2 (Figure 3.4). A ten-story building, Council House 2 reduces electricity consumption by 82 percent, gas consumption by 87 percent, greenhouse emissions by 87 percent, and potable water consumption by 72 percent.

Figure 3.4 : Melbourne's Council House 2 in Australia. Wind turbines assist in the release of the building's exhaust (source: Url-6)

3.3.5 NABERS (Australia)

Australia also has NABERS (National Australian Built Environment Rating System). Launched in 2005, this green standard rates an existing office building's overall environmental performance in several categories: energy, refrigerants (greenhouse and ozone depletion potential), water use, stormwater runoff and pollution, sewage, landscape diversity, transport, indoor air quality, occupant satisfaction, waste, and toxic materials.

3.3.6 CASBEE (Japan)

Japan imports more natural gas than any other country in the world, and it purchases nearly 90 percent of its oil from the Middle East. Energy-efficient green buildings have, therefore, been at the forefront of a wide variety of Japanese regulations and policies (Lockwood, 2007).

The Japan Sustainable Building Consortium/ The Institute for Building Environment and Energy Conservation (Japan's Green Building Council) issued Japan's green building standard, the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), in June 2004.

CASBEE cover energy, resources and materials, air pollution, wind damage, sunlight obstruction, light pollution, noise and acoustics, thermal comfort, lighting and illumination, indoor air quality, service ability, durability, reliability, flexibility, and adaptability.

Figure 3.5 : Pump Manufacture Co Ltd, Tokyo Branch Building: Class A in CASBEE (source: Url-7)

3.3.7 GOBAS (China)

In the midst of the world's biggest construction boom, China is also undergoing a population boom, rapid urbanization, escalating energy demands, and crippling pollution. It contains 16 of the 20 most polluted cities in the world. Operating with coal-burning power plants and other polluters, the country emits the most sulphur dioxide in the world.

China also has begun to embrace the green building movement. In June 2006, the country released its Evaluation Standard for Green Building, which covers the performance of new buildings, building extensions, and renovations. The Evaluation Standard's main criteria are: land conservation and environmental protection, energy conservation and use, water conservation and use, materials conservation and resource use, indoor environmental quality and management (residential buildings), and lifecycle performance (public buildings).

Of particular importance is China's Green Olympic Building Assessment System (GOBAS), which was implemented in 2003 to guide the entire planning and development process of facilities for the upcoming 2008 Summer Olympics in Beijing. Following the Olympics, GOBAS will be evaluated, revised, and turned into a national Chinese green building standard.

3.4 A Closer view to LEED and BREEAM

Many countries have already their own green building rating systems or either adopted the green building guidelines or are in the process of adopting them. When choosing an environmental rating for a building outside the UK, USA, Japan or Australia etc.., it is generally preferable to use the local system. But, where there is not a local rating system; both LEED and BREEAM claim to be usable anywhere in the world and the most common ones in use.

BREEAM and LEED are the two most widely recognized environmental assessment methodologies used globally in the construction industry today. Each has different strengths and weaknesses, with differing philosophies and business models. Generally it is not straightforward to compare the two. What might be applicable in one assessment method might not be relevant in another.

Choosing an environmental-performance system for a proposed building is a very difficult decision to make; a wrong choice has repercussions to both project cost and design quality. A right decision, however, can dramatically improve the design and quality of a building, as well as its environmental impact and the health of its occupants. This part of the section aims to give you the necessary background and help you make an informed decision about.

Rating the environmental performance of a building is necessary to ensure that its green credentials incorporate both the visible and invisible elements that make it 'green'. Visible green methods, sometimes described as 'eco-bling', such as photovoltaics, are clearly evident on a building; however, invisible methods like energy efficiency are often more important and can only be identified and recorded by rating or certification.

Real estate developers are also increasingly advising applicants to produce green buildings, so certification is sometimes a requirement and can help many projects. In the following, it is provided that comparison of the two major leading systems.

3.4.1 LEED

LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Developed by the U.S. Green Building Centre (USGBC), LEED provides building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

LEED is flexible enough to apply to all building types, commercial as well as residential. It works throughout the building lifecycle, design and construction, operations and maintenance, tenant fitout, and significant retrofit. And LEED for Neighborhood Development extends the benefits of LEED beyond the building footprint into the neighborhood it serves.

There are **8 versions of LEED** and **2 further versions** under development:

- New Commercial Construction and Major Renovation projects
- Existing Building Operations and Maintenance
- Commercial Interiors projects
- Core and Shell Development projects
- Homes
- Neighbourhood Development
- LEED for Schools
- LEED for Retail
- LEED for Healthcare (under development)
- LEED for Labs (under development)

3.4.1.1 LEED Assessment information

LEED is a voluntary certification program that can be applied to any building type and any building lifecycle phase. It promotes a whole-building approach to sustainability by recognizing performance in key areas:

- **Sustainable Sites :**

  Choosing a building's site and managing that site during construction are important considerations for a project's sustainability. The Sustainable Sites category discourages development on previously undeveloped land; minimizes a building's impact on ecosystems and waterways; encourages regionally appropriate landscaping; rewards smart transportation choices; controls stormwater runoff; and reduces erosion, light pollution, heat island effect and construction-related pollution.

- **Water Efficiency :**

  Buildings are major users of our potable water supply. The goal of the Water Efficiency credit category is to encourage smarter use of water, inside and out. Water reduction is typically achieved through more efficient appliances, fixtures and fittings inside and water-wise landscaping outside.

- **Energy & Atmosphere :**

  According to the U.S. Department of Energy, buildings use 39% of the energy and 74% of the electricity produced each year in the United States. The Energy & Atmosphere category encourages a wide variety of energy strategies: commissioning; energy use monitoring; efficient design and construction; efficient appliances, systems and lighting; the use of renewable and clean sources of energy, generated on-site or off-site; and other innovative strategies.

- **Materials & Resources :**

  During both the construction and operations phases, buildings generate a lot of waste and use a lot of materials and resources. This credit category encourages the selection of sustainably grown, harvested, produced and transported products and materials. It promotes the reduction of waste as well as reuse and recycling, and it takes into account the reduction of waste at a product's source.

- **Indoor Environmental Quality :**

The U.S. Environmental Protection Agency estimates that Americans spend about 90% of their day indoors, where the air quality can be significantly worse than outside. The Indoor Environmental Quality credit category promotes strategies that can improve indoor air as well as providing access to natural daylight and views and improving acoustics.

- **Locations & Linkages :**

The LEED for Homes rating system recognizes that much of a home's impact on the environment comes from where it is located and how it fits into its community. The Locations & Linkages credits encourage homes being built away from environmentally sensitive places and instead being built in infill, previously developed and other preferable sites. It rewards homes that are built near already-existing infrastructure, community resources and transit, and it encourages access to open space for walking, physical activity and time spent outdoors.

- **Awareness & Education :**

The LEED for Homes rating system acknowledges that a green home is only truly green if the people who live in it use the green features to maximum effect. The Awareness & Education credits encourage home builders and real estate professionals to provide homeowners, tenants and building managers with the education and tools they need to understand what makes their home green and how to make the most of those features.

- **Innovation in Design :**

The Innovation in Design credit category provides bonus points for projects that use new and innovative technologies and strategies to improve a building’s performance well beyond what is required by other LEED credits or in green building considerations that are not specifically addressed elsewhere in LEED. This credit category also rewards projects for including a LEED Accredited Professional on the team to ensure a holistic, integrated approach to the design and construction phase.

- **Regional Priority :**

USGBC's regional councils, chapters and affiliates have identified the environmental concerns that are locally most important for every region of the country, and six LEED credits that address those local priorities were selected for each region. A project that earns a regional priority credit will earn one bonus point in addition to any points awarded for that credit. Up to four extra points can be earned in this way.

3.4.1.2 Scoring and weightings

LEED points are awarded on a 100-point scale, and credits are weighted to reflect their potential environmental impacts. Additionally, 10 bonus credits are available, four of which address regionally specific environmental issues. A project must satisfy all prerequisites and earn a minimum number of points to be certified. Point weightings are as follows (Table 3.1) :

Table3.1: Leed for New Construction Point Weightings (source : Url-2)

Total Possible Points	**110** *
Sustainable Sites	26
Water Efficiency	10
Energy & Atmosphere	35
Materials & Resources	14
Indoor Environmental Quality	15
***** out of a possible 100 points	**+10 bonus points**
Innovation in Design	6
Regional Priority	4

A project's total score determines its ultimate certification level. Project must earn **at least 40 points** to be certified (Table 3.2).

Table3.2: Leed Certification Scores (source : Url-2)

Certified	40 +
Silver	50 +
Gold	60 +
Platinum	80 +

3.4.1.3 Assessment process

The project team compile the documentation required for the assessment. A trained assessor is therefore not required, although there is a credit available for appointing a LEED AP (LEED Accredited Professional) as part of the design team. Once all the documentation has been compiled by the project team it is submitted to the USGBC who review the evidence and calculate the score. Assessments are completed either by using an online application procedure LEED Online, or as hard copy. The USGBC allow 25 working days to review LEED submissions although project teams can pay an additional $10,000 to receive an expedited review which would take 12 working days. LEED Online submissions take the USGBC 12 working days to assess. The total time between initial submission to the USGBC and issue of the certificate can vary from 27 working days to as many as 65 working days.

If the design team feel that the USGBC has made an unfair assessment the project team are given 25 working days to appeal. A charge of $500 is made for each credit assessment appealed against. Once the final score has been accepted by the project team the USGBC issue a certificate and a plaque with the rating on it. It is worth noting that they fully rebate certification fees for any project awarded LEED platinum certification. LEED Accredited Professionals are not required to be licensed so far. There are 45,162 LEED Accredited Professionals to become a LEED Accredited Professional an exam is taken, at a cost of $350 (for non USGBC members). It is likely that delegates will attend a LEED workshop at a cost of $495 (for non USGBC member) before taking the exam. In contrast the money that people charge for putting the paperwork together for a LEED assessment can be as much as $75,000.

3.4.2 BREEAM

BREEAM was first launched in 1990 and is currently updated annually to keep ahead of UK Building Regulations and to stay in line with current best practice. The first version of BREEAM was developed to assess the environmental performance of offices. BREEAM addresses wide-ranging environmental and sustainability issues and enables developers and designers to prove the environmental credentials of their buildings to planners and clients. It:

- uses a straightforward scoring system that is transparent, easy to understand and supported by evidence-based research
- has a positive influence on the design, construction and management of buildings
- sets and maintains a robust technical standard with rigorous quality assurance and certification

Since then schemes have been developed to cover the following **16 versions** of buildings:

- **BREEAM Retail :** can assess new build or major refurbishment, post construction, tenant fit-out, existing (occupied), management and operation.
- **BREEAM Industrial :** can assess storage & distribution, light industrial units, factories and workshops at the design stage and post construction.
- **BREEAM Offices :** can assess new build or major refurbishment and existing offices, at the design stage, post construction and in use.
- **BREEAM Education :** can assess new schools, major refurbishment projects and extensions at the design stage and post construction.
- **BREEAM Multi – Residental :** can assess student halls of residence, sheltered housing for the elderly, supported housing and hostel type accommodation at the design stage and post construction.
- **BREEAM Courts :** can assess both new build and the major refurbishment of court buildings. BREEAM Courts assessments are certified through the Bespoke BREEAM.

- **BREEAM Prisons :** can assess high and standard security prisons, young offenders institutions, local prisons and women's prisons at the design stage and post construction.
- **BREEAM Health :** can be used to assess all healthcare buildings containing medical facilities, and at different stages of their lifecycle.
- **BREEAM Healthcare XB :** also offers a solution for existing buildings in operation.
- **BREEAM Ecohomes :** can assess new homes, apartments/flats, and houses, apartments and flats undergoing major refurbishment at the design stage and post construction.
- **BREEAM Ecohomes XB :** can be used for housing associations and housing stock managers as a stock management aid for existing buildings.
- **BREEAM Domestic Refurbishment :** BRE Global is developing a new standard to enable the sustainable refurbishment of existing housing titled BREEAM Domestic Refurbishment.
- **BREEAM Communities :** This new BREEAM scheme helps planners and developers to improve, measure and independently certify the sustainability of development proposals at the planning stage.
- **BREEAM Other Buildings :** can assess buildings that fall outside the standard BREEAM categories, including leisure complexes, laboratories, community buildings and hotels at the design stage and post construction.
- **BREEAM International :**can assess a single development or BRE can also assist in creating a BREEAM version for a country or region outside of UK.
- **BREEAM In-Use :** is a new scheme to help building managers reduce the running costs and improve the environmental performance of existing buildings.

Each of the assessment tools can be used at different stages of the building's life, indicates which version can be used at which stage. BREEAM Design and Procurement (D&P) can be used during the design stage of a refurbishment project or

for a new build or extension project. The Post Construction Review (PCR) is carried out once the construction is complete to verify the D&P assessment. The Fit Out assessment is carried out during major refits of existing buildings and a Management and Operation (M&O) assessment is carried out to assess the performance of a building during its operation (Table 3.3).

Table 3.3: Breeam assessment tools during building's life

	D&P	**PCR**	**Fit Out**	**M&O**
Offices	o	o	o	o
Schools	o	o		
Retail	o	o	o	o
Industrial	o	o		
Prisons	o	o		
Healthcare	o	o		o
Courts	o	o		
Multi – Residental	o	o		o

BREEAM is used all around the world and can be used to assess a single development or a portfolio of developments both within and across national boundaries. BREEAM has a particular benefit in that it can be readily adapted to local regulation and conditions.

Specific versions of BREEAM are available for the UK, the Gulf and Europe. BREEAM schemes can also be tailored for use for any specific country or region, and will address the following:

- categories of environmental issues

- environmental weightings

- details of the construction methods, products and materials

- references to local codes, standards and good practice guides

There have been more than 100,000 buildings certified by BREEAM of which 1358 are non domestic buildings. There are currently more than 500,000 buildings registered of which 3177 are non domestic buildings. There are a total of 1473 registered assessors operating within 820 licensed assessor organisations.

3.4.2.1 BREEAM Assessment information

BREEAM asseses the performance of buildings in the following key areas :

- **Management :** Overall management policy, commissioning site management and procedural issues.
- **Health & Wellbeing :** Indoor or external health and wellbeing.
- **Energy :** Operational energy and carbon dioxide issues
- **Transport :** Transport related carbon dioxide and located – related factors.
- **Water :** Consumption and water efficiency .
- **Materials :** Environmental implication of building materials, including life – cycle impacts
- **Land Use & Ecology :** Green fields and brown fields sites and ecological value conservation and enhancement of the site.
- **Pollution :** Air and water pollution issues.

3.4.2.2 Score calculation and certification rating

The BREEAM methodology calculates an environmental rating by awarding points, or credits, for meeting the requirements of series of criteria that, if complied with, would result in a reduction of the building's negative environmental impact and an increase in its environmental benefits. Each of the criteria is usually worth a single credit except where there is a large variation in the performance of buildings which meet the requirements of the criteria. For example Reduction in CO2 Emissions is assigned 15 credits awarded on a scale which runs from one credit for a building just above the minimum level required to meet UK Building Regulations, up 15 credits for a building which has net carbon emissions of zero.

The criteria are grouped into issue categories which are Energy, Water, Materials, Transport, Management; Health and Wellbeing, Land use & Ecology, and Pollution. Each of these environmental issue categories is weighted according to the perceived importance of the environmental issues that the section aims to address. The weightings are applied to the percentage score for each issue category. Once added together this gives the environmental score (Figure 3.6).

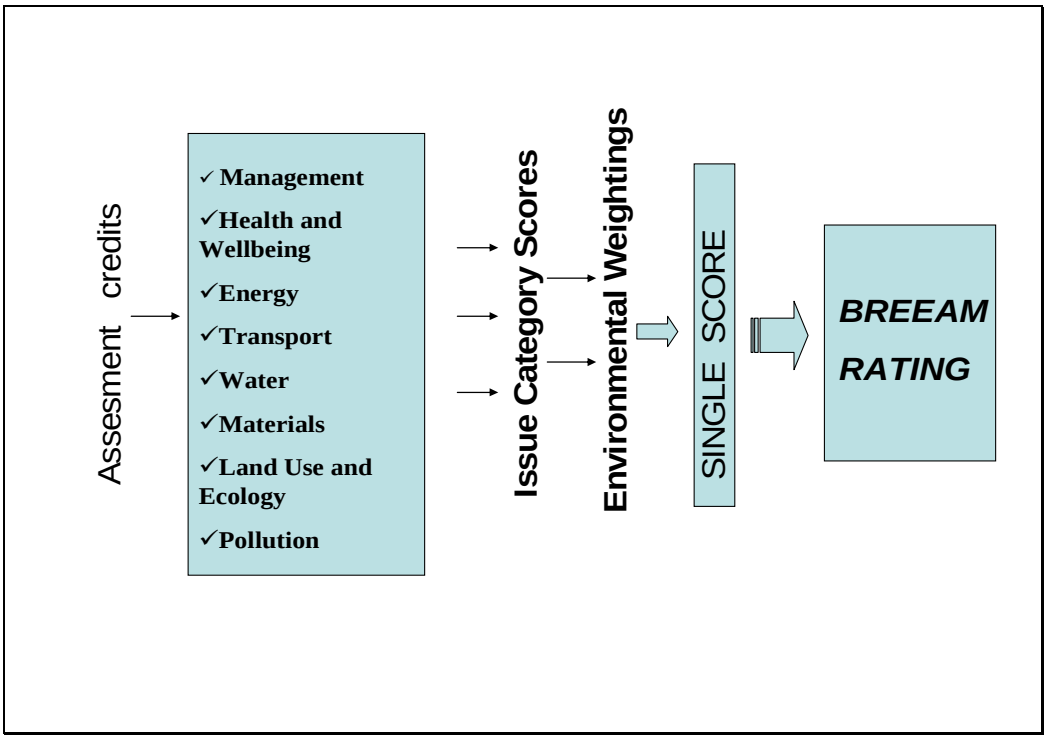

Figure 3.6: Breeam Score Calculation

The BREEAM rating is then awarded based on the score achieved. There is some slight variation between the rating bands for each version but the majority of ratings are awarded on the following scale (Table 3.5) :

Table 3.5: Breeam Certification Rating

Pass	25 %
Good	40 %
Very Good	55 %
Excellent	70 %

The issue category weightings were set following a consultation with a variety of construction industry stakeholders including academics, construction industry professionals, lobbyists and scientists.

3.4.2.3 Assessment process

BREEAM assessments are carried out by licensed assessors. BREEAM trains, examines and licenses organisations and individuals to help design teams (or facilities management companies) gather the appropriate data and to carry out the assessments.

The cost of becoming a BREEAM assessor is £950 ($1886) to complete the training, plus approximately £2500 ($4964) for a BREEAM offices licence. The maximum recommended cost of £10,000, for a very large project to be BREEAM assessed, makes it difficult to justify unless an individual has already got some clients requiring a BREEAM assessment.

For each assessment, the assessor produces a report outlining the development's performance against each of the criteria, its overall score and the BREEAM rating achieved. This report is sent to BREEAM who review the report using a strictly defined quality assurance process. Once a report has successfully passed the Quality assurance process, BREEAM issues the client with a certificate that confirms the development's BREEAM rating.

All aspects of the BRE's operation of BREEAM are accredited under ISO9001. Assessors qualified to deliver the BREEAM assessments are also covered under a UKAS accredited competent persons scheme. In addition, the operations relating to the certification of the

BREEAM buildings versions are also covered under UKAS (the United Kingdom Accreditation Service) accredited product certification schemes.

The time an assessment takes to complete varies according to the agreement between client and assessor, and the fee can vary between £2,000 and £10,000 ($3971-$19857). There is also a QA / certification fee which is paid, through the assessor, to BREEAM. This fee varies, between £740 and £1500 ($1469-$2979), according to the size of the building being assessed.

Once the assessment report is submitted to BREEAM for quality assurance and certification it will take 15 working days for the quality assurance checks to be carried out. If the report is complete and the assessment correct a BREEAM certificate is sent directly to the client. If revisions are required a feedback form is provided to the assessor stating the changes required. Once resubmitted to BREEAM the report will then be reviewed within 5 working days.

During the assessment process BREEAM provide support to the assessors. Providing help in interpreting the criteria and setting precedents, where necessary. A dedicated email address and phone line ensures that assessors receive a response within 48 hours of submitting a query. An extranet provides additional guidance for assessors on frequently asked questions, process updates, and precedents that have been set that have a bearing on subsequent assessments.

In order to become a BREEAM assessor an individual must complete the training at a cost of £950 ($1886). Once the exam and test assessment have been successfully completed the BREEAM assessor must pay a further £2500 ($4964) for a BREEAM offices licence.

3.4.3 Comparison of LEED and BREEAM

The rating of buildings in terms of environmental performance has been growing rapidly over the last decade using systems like BREEAM in the UK and LEED in the US. In the UK, BREEAM may be incorporated into the building regulations by 2019 in line with the push towards building and living more sustainably. However, as these systems develop around the world, developers and architects are currently facing a very difficult decision in choosing which one to use.

Choosing an environmental-performance system for a proposed building is a very difficult decision to make; a wrong choice has repercussions to both project cost and design quality.

A right decision, however, can dramatically improve the design and quality of a building, as well as its environmental impact and the health of its occupants.

Rating the environmental performance of a building is necessary to ensure that its green credentials incorporate both the visible and invisible elements that make it ‘green’. Visible green methods, sometimes described as ‘eco-bling’, such as

photovoltaics, are clearly evident on a building; however, invisible methods like energy efficiency are often more important and can only be identified and recorded by rating or certification.

Both BREEAM and LEED assess buildings against a wide range of environmental and sustainability issues covering a number of categories. For each issue, one or more 'credits' are available when specific levels of performance or process are achieved.

Overall, the total number of points or credits obtained determines the final LEED or BREEAM score, which results in a rating, ranging from Pass to Outstanding for BREEAM, and Certified to Platinum for LEED.

Here we can summarise some basic differences like below (Table 3.7) :

- Buildings outside the UK can be assessed using BREEAM International, which is tailored to suit local circumstances. A BREEAM International assessment relies on the BRE setting up a list of criteria specifically for the project, or for series of projects which have similar characteristics. It is carried out by **an accredited assessor** who then submits a report to the BRE for Quality Assurance, resulting in a rating such as Pass, Good, Very Good, Excellent, or Outstanding and a BREEAM certificate.
- The LEED scheme has been inspired by the other schemes including BREEAM. Unless a country-specific LEED system is in place, the LEED US Criteria are used for any country in the world. The LEED **Accredited Professional (LEED AP)** gives support and guidance to the Design Team on LEED issues, but the LEED certification is provided by independent, third-party verification from the **USGBC.**
- BREEAM has over 110,000 certified buildings, most of which are residential projects. Although the USGBC is a large organisation, fewer than 2,000 buildings, (mostly commercial), have acquired LEED rating.
- As an other important difference, If we try to fit the LEED credits into the BREEAM UK categories, such as water, energy, pollution, air quality, ecology, use of land and transport; we will find out that LEED gives slightly more importance to the occupant's health and comfort, while BREEAM would tend to be more focused around environmental impacts.

- Overall, the weightings are comparable, but the detail of the criteria differs significantly. The criteria for both systems rely extensively on regulations, guidance and third-party standards.
- As the two methods use different standards, the fact that a credit is achieved in one method won't guarantee the equivalent being achieved with the other. So a building that receives a high BREEAM International rating may score relatively poorly at LEED, and vice-versa.
- Overall, as regulations in the UK are tougher than in the US, the criteria from BREEAM UK may be slightly more onerous than that of LEED and this difference may be reflected in BREEAM International to some extent.
- However, BREEAM International uses local guidance, regulations, climatic distinctiveness and environmental priorities, so ultimately it is very likely that its criteria are easier to comply with than LEED.
- And, for many major LEED credits, American standards for heating and energy must be used along with imperial units, so the conversion of these measurements makes the process more complex and arduous.
- There is very little information about the construction cost implications of pursuing LEED or BREEAM for international projects. Added construction costs will depend on how the regional standards compare to the assessment standards. And where, for example, some sources give added costs of 3 to 8 per cent of construction costs for LEED accreditations, one could expect that these might be significantly higher should the system be applied to a non-US country. This may partly be due to building regulations being disparate (for example, in relation to energy performance). The other added difficulty is that supply processes, contractors and suppliers may not be familiar or adapted to the requirements, or there may be a lack of green building products. As BREEAM International is bespoke to each country, it is expected that the added cost may be equal or possibly lower than that of LEED despite a higher level of environmental performance.

Table 3.7: Comparison of LEED and BREEAM

BREEAM	**LEED**	
OTHER BUILDINGS, COURTS, ECOHOMES, HEALTHCARE, INDUSTRIAL, INTERNATIONAL, MULTI–RESIDANTIAL, PRISONS, OFFICES, RETAIL, EDUCATION, COMMUNITIES, DOMESTIC REFURBISHMENT	HOMES, NEIGHBORHOOD DEVELOPMENTS, COMMERCIAL INTERIORS, CORE&SHELL, NEW CONSTRUCTION, SCHOOLS, HEALTHCARE, RETAIL, EXISTING BUILDINGS&MAINTENANCE	**VERSIONS**
MANAGEMENT HEALTH& WELLBEING ENERGY&TRANSPORT WATER MATERIALS & WASTE LAND USE & ECOLOGY POLLUTION	SUSTAINABLE SITES WATER EFFICIENCY ENERGY&ATMOSPHERE MATERIALS&RESOURCES INDOOR ENVIRONMENTAL QUALITY LOCATON&LINKAGES AWARENESS&EDUCATION INNOVATION IN DESIGN REGIONAL PRIORITY	**KEY AREAS (ISSUE CATEGORIES)**
APPLIED TO EACH ISSUE CATEGORY (CONSENSUS BASED ON SCIENTIFIC / OPEN CONSULTATION)	ALL CREDITS EQUALLY WEIGHTED, ALTHOUGH THE NUMBER OF CREDITS RELATED TO EACH ISSUE İS WEIGHTING	**WEIGHTINGS**
PASS / GOOD / VERY GOOD / EXCELLENT / OUTSTANDING	CERTIFIED / SILVER / GOLD / PLATİNUM	**RATINGS**
TRAINED ASSESSORS	USGBC	**ASSESMENT**
ANNUAL	AS REQUIRED	**UPDATE PROCESS**

Table 3.7: Comparison of LEED and BREEAM (continuing)

BREEAM	LEED	
93% (1998 – 2007)	86% (2002 – 2007)	**COMPOUND ANNUAL GROWTH RATE**
110808	1823	**NUMBER OF UNITS CERTIFIED**
109450	540	**DOMESTIC**
1358	1283	**NON – DOMESTIC**
£2000 - £10000 ($3971 - $19857)	UP TO £37770 ($75000)	**ASSESSMENT / COLLATION FEE** *
£740 - £1500 ($1469 - $2979)	£1133 - £11331 ($2250 - $22500)	**CERTIFICATION FEE**
FREE	£252 ($500)	**COST OF CREDIT APPEALS**
FREE / UNLIMITED NUMBER	£111 ($220) UNLIMITED NUMBER	**CREDIT INTERPRETATION REQUESTES COST / ALLOWANCE**
ESTIMATOOR TOOLS ARE AVAILABLE FREE OF CHARGE. GUIDANCE IS CURRENTLY ONLY AVAILABLE TO PEOPLE WHO ATTEND THE TRAINING COURSES	THE TOOLS ARE AVAILABLE FREE OF CHARGE AND TECHNICAL GUIDANCE IS AVAILABLE FOR £100 ($200)	**AVAILABILITY OF ASSESSMENT INFORMATION**

Note : *Amounts shown in this table are in £ sterling and (US $) using the following exchange rates:* £0.50360 = US$1, £0.40311 = AUS$1, US$0.80045 = AUS$1

*******Assessment costs for different schemes may include varying tasks. This makes it difficult to make a direct comparison.*

3.5 Evaluation

While green building rating systems are proliferating around the world, and within individual countries, real estate developers still ignore them in favor of development as usual. This recalcitrance systems, in part, from a lack of willingness to change, and because many markets are not demanding that the real estate industry change. The problem comes down to lack of knowledge. Most people are unaware that green building standards exist, and they do not understand why they are important, or which standards are superior to others.

Compounding these problems are the lack of a global definition of what truly constitutes a green building, and the lack of a global valuation system to measure accurately a green building's performance. Green building rating systems themselves are a problem. Some of them are not rigorous enough, others are too complicated. Similarly, many supposed green building rating systems focus solely on one or two aspects of green building development, primarily energy efficiency.

These drawbacks, however, are only slowing not stopping the advance and growing importance of green building around the world. More and more users from office tenants to homebuyers are demanding buildings that meet basic sustainable standards. More and more cities, states, and national governments are mandating basic green standards. Real estate markets now are rewarding green buildings with higher rents and sales prices.

Finally, before very long, green building standards will be the norm, not the exception, in many nations around the world. And , as a conclusion; where there is not a national green building rating system, **BREEAM** International is a serious contender to LEED and quite possibly the better option in achieving greener, high-quality buildings in green real estate development projects.

After an overview on green building movement of Turkey in the next section, BREEAM option is analyzed more detailed on the case of Erzurum Shopping Center supporting this section's final evaluation.

4. AN ASSESSMENT FOR TURKEY AND THE CASE OF ERZURUM SHOPPING CENTER

4.1 Introduction

Turkey's building industry has recently been in a process of rapid development. Commercial high-rises are increasingly advertising "green" and green building case studies are growing. Government policy is becoming more aligned with Turkey's energy deficit and external pressures further encourage environmentally responsible development. Also, international investors and non-profits are importing an environmentally conscious methods to some of Turkey's high-profile developments.

In this section, current status of green building in Turkey will be analyzed in the scope of thesis. Moreover, Breeam option, which is chosen in the previous section to apply if there is not a national green building, is analyzed to find out the benefits and obstacles for Turkey in the transition period of developing a national green building rating system.

4.2 Green Building Movement in Turkey

Turkey has dynamic economic development and rapid population growth. It also has macro-economic, and especially monetary, instability. The net effect of these factors is that Turkey's energy demand has grown rapidly almost every year and is expected to continue growing. The domestic share of total energy consumption is 37%, and between the years 2000 and 2010, the cost for needed energy will be approximately 55 billion US$. The government has been planning for 81% of this amount as an investment. Considering the country's economic conditions, Turkey must come up the plan which reduces the share of fossil fuels (Koyun, 2007).

36% of energy used in Turkey annually is for the buildings (Keskin, 2008). The largest amount of carbon dioxide emissions in Turkey comes from the burning of fossil fuels for buildings (Figure 4.1).

This makes buildings the single highest contributor to the greenhouse gas emissions that cause climate change as well as locations of some of the most effective opportunities to reduce these emissions.

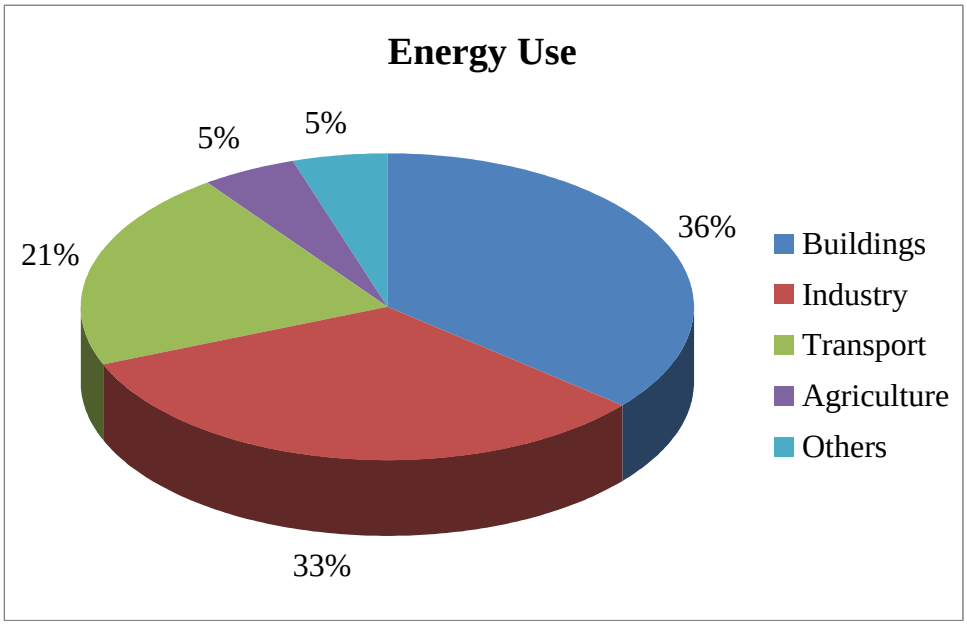

Figure 4.1 : Relative Shares in Turkey's Energy Use (source : Keskin, 2008)

In this context, green buildings obviously will reduce the use of other forms of energy, especially fossil fuels as particulates and greenhouse gases in the country. In order for building industry to reduce CO2 emissions, we need to build green and retrofit to make existing buildings green.

Green building in Turkey has reached an unprecedented peak in many ways. Unheard of several years ago, now major commercial developments advertise an awareness of environmental issues, or a design premised on sustainable principles. Malls and major office developments are engaging in green retrofit processes. These recent developments, however limited, signal the entrance of green building into Turkey's mainstream building industry (Erten, D., 2009).

Turkish Green Building Association has been established with intentions to be a Green Building Council (GBC) in October 2007. The association has been lobbying on green buildings since then.

Turkey's green building industry exists in a nexus of market forces like commercial sector, national governments, academia, and technology.

4.2.1 First Practices of Green Building Movement

Not all green buildings in Turkey are class-A properties, nor are they recently built (Erten, D., 2009). The METU Solar House in Ankara, built in 1975-6, is Turkey's first green building case study (Figure 4.2).

Figure 4.2 : METU Solar House in 1995 (source : Url-9)

Several solar houses followed, including Cukurova University Solar House and the (MTA) Solar House in 1981, the Greater Ankara Municipality Solar House in 1993, TUBITAK National Observatory. Guest-House and the Erciyes Active Solar House in 1996.

Figure 4.3 : Diyarbakır Solar House (Source : unknown)

The Diyarbakir Solar House, sponsored by the Diyarbakir Municipal government in 2008, shows a recent continuation of this trend (Figure 4.3). The houses use a variety of solar technologies such as direct-heated ventilation air, solar flat-plate collectors, photovoltaic cells, and passive solar heating systems.

Besides the METU example, they were all built to display the potential to use solar energy in Turkey's residential development (Hepbasli, et. al. 2004).

More holistic approaches to green building can be found as well. The Eco-Center at Kerkenes was originally founded as a research outpost for a nearby archeological dig. Francoise Summers, a member of the Middle East Technical University's faculty of architecture, developed the site into several buildings in 2002 (Figure 4.4).

Figure 4.4 : Eco Center at Kerkenes, Sorgun; Yozgat (2008) (source : Url-9)

METU students and local entrepreneurs use the facility for studying sustainable building techniques, low-tech uses of renewable energy, and local economic integration. Nevzat Sayin, one of Turkey's most respected architects, also designed locally-sensitive buildings for the town of Yaşibey in 1997. While they are not advertised as "green," the modern summer homes aesthetically and urbanistically fit into the fabric of the traditional town.

Furthermore, in both high cases the structures are built with locally supplied materials and knowledge, and traditional building techniques. By these standards, their environmental sustainability can be considered on par with many of their

modern commercial counterparts. There is also an Eco-Building designed by HAS architecture to be built at Istanbul Technical University Maslak Campus in 2009. This project works on the "zero energy" principle. The building is planning to apply for an international green building certification system (Figure 4.5)**.**

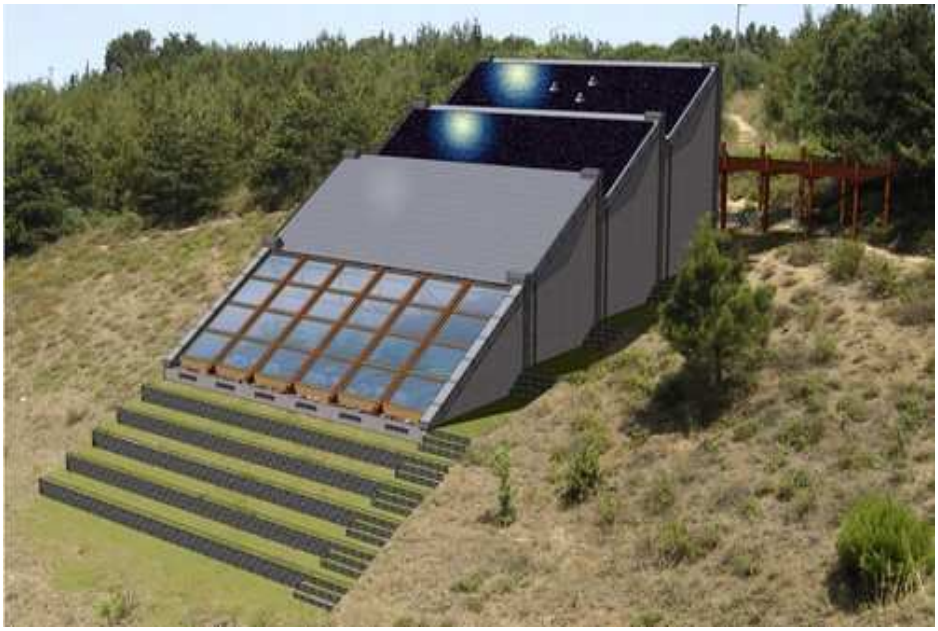

Figure 4.5 : İstanbul Technical University Maslak Campus in 2009 (source : Url-10)

4.2.2 Commercial Sector Buildings

Commercial buildings are taking the lead in green building movement. But, the recent development of green building in the Turkish commercial sector has been closely tied to the international community. As an example, two of Turkey's largest retail developers, **Metro** and the Dutch-based **REDEVCO**, have corporate-wide sustainability policies. REDEVCO Turkey has developed of its first two shopping center developments in Turkey. **Gordion Shopping Center**, which is being developed in Ankara, Turkey's capital and second largest city (Figure 4.6). And **Erzurum Shopping Center** in Erzurum, the largest city in the Eastern Anatolia Region opened their doors in the second half of 2009. To improve energy efficiency and to promote green design, both the Gordion and the Erzurum Shopping Centers, designed and developed according to BREEAM standards.

Figure 4.6: The Gordion Shopping Center in Turkey which has a BREEAM certificate. (source : Url-11)

Also, construction companies like **SOYAK, ZORLU, TEKFEN** and **ECZACIBASI** are developing green building policies. For example, Unilever has **Unilever Umraniye Office**, the first LEED certified project in Turkey. Unilever's 10.000 m2 office in Umraniye-Istanbul has been designed per the LEED criteria.

Figure 4.7 : Turkey's first LEED Certificated Office Building, Unilever Umraniye (source : Url-10)

The project included rainwater harvesting which helped achieve over 40% water efficiency for the project. High efficiency HVAC equipment has been used together with fully automated lighting control system with sensor which resulted in a calculated energy savings of over 30% compared to conventional offices. Unilever has also aimed to provide its workers a more healthy environment by maximizing Indoor Air Quality levels and allowing them to see the outside from their work stations (Figure 4.7)**.**

Furthermore, **Tekfen OZ Levent Office Building**, with the integration of LEED criteria into the design, the building envelope and HVAC system design have been considerably improved to maintain maximum energy efficiency. The construction continues in this 16.000 m2 office building that has exemplary green applications (Figure 4.8).

Figure 4.8 : Tekfen Oz Office Building in Levent, İstanbul; LEED certified Office building (source : Url-12)

Also, Turkish-owned Kanyon Mall both won the 2006 Cityscape Architectural Review Award and employed the London-based firm ARUP, which specialized in advanced green engineering, as project engineers.

These developments indicate that “green” design and operations are achieving cache for both building owners and potential buyers alike.

4.2.3 Goverment Policies

As a political entity, Turkey first engaged with the environment in 1978 with the establishment of the Undersecretariat for the Environment. Five years later, the 1982 Constitution included the “right to live in a healthy, balanced environment,” and in 1983, the first Environmental Law was passed. Several environmentally directed laws followed, including regulations on pollution and the Mass Housing Law of 1984.

Then in 1992, responsibility for Turkey’s environmental management was given to the new Ministry of the Environment, which still exists today. A key piece of legislation was the Environmental Impact Assessment law of 1992, requiring municipal approval of all public land development. Generally, however, development interests have trumped the environmental intent of this law (Calguner 1999).

Recently, regulations for Turkey’s accession into the EU have increased incentive on environmental reform, though little progress has been found (Turkey Progress Report). Another motivating factor for green building and environment came from the UN-HABITAT II forum, held in Istanbul in 1996. This international event was a watershed for ideas on improved urban habitat and building.

Turkey’s energy dependence and the need for energy efficiency has also prompted regulatory and rhetorical changes in the name of energy efficiency law in 2007.

In 2008, the central government finished implementing insulation requirements for both commercial and residential buildings. One hundred percent compliance would be expected to save billions of dollars and 70% of the country’s heating energy. Though not directly related to the environment, per se, these measures to represent an advancement of the building industry (Erten, D., 2009).

4.2.3.1 Energy Efficiency Law

The Energy Efficiency Law was enacted on May 2007 to give a new impulse to energy to energy efficiency.

The objective of this law is to increase the efficient use of energy and energy resources for reducing the burden of energy costs on the economy and protecting the environment. This law comprises organization, principals and procedures in order to

increase the energy efficiency in industry, electrical power plants, transmission and distribution systems, building, and transport sectors.

The main components of the Law are:

- ✓ To set up an administrative structure (the establishment of an 'Energy Efficiency (EE) Coordination Board', with responsibility to implement, supervise and coordinate the energy efficiency activities of relevant organisations and mechanism for energy management and efficiency services;

- ✓ To increase energy efficiency awareness through energy conservation week, the media, training in schools, competitions, etc…

- ✓ To promote energy efficient equipment and vehicles;

- ✓ To supply financial support to energy efficiency projects and enterprises through voluntary agreements.

- ✓ The Law also states that Energy Managersshould be assigned in industrial and commercial enterprises and buildings(which have a certain level of annual energy consumption).

- ✓ In addition, energy labelling/energy usage identification for efficient energy use, a "Building Energy Performance Certificate" will be issued by the Ministry of Public Works, especially for larger buildings.

4.2.3.2 Recent Regulations Related to Buildings

Some implementing on Energy Efficiency Law were finished during the year of 2008. Some major regulations related to buildings are below:

- **April 14, 2008 (As a secondary legislation of dividing heat expenditures in buildings) :**
  - ✓ Individual heat meters application for the buildings having central heating systems

- **October 25, 2008 (As a secondary legislation on increasing energy resources and energy efficiency on energy usage) :**
    - ✓ Appointment of Energy managers for services and public buildings with a minimum construction area of twenty thousand square meters or with an annual energy consumption of five hundred toe (for public building the limits is decreased by half).

    - ✓ The Mass Housing Administration shall primarily analyze the possibilities of using cogeneration and heat pump systems and solar energy in mass housing projects. The applications not exceeding ten percent of house cost shall be carried out.

    - ✓ In opening mass housing areas to settlement, Municipalities and Mass Housing Administration shall give priority to regions where central and local heating and cooling is possible through thermal power plant waste heat and shall take necessary measure for heat distribution infrastructure plans.

    - ✓ Measures for increasing energy efficiency at buildings and enterprises belonging to the public sector is also defined with this regulation

- **December 5, 2008 (As a secondary legislation in energy performance in buildings) :**
    - ✓ For more efficient buildings, minimum performance criteria concerning the architectural design, heating and/or cooling, equipment, insulation requirements, materials, electrical installations, lighting and control will be implemented.

    - ✓ Establishment of energy certificates called **"Building Energy Performance Certificates"** which will contain information on the energy requirements, insulation features and efficiency of the heating and/or cooling systems of a building as well as the building's energy classification for use during selling, renting or owner transferring (Figure 4.9).

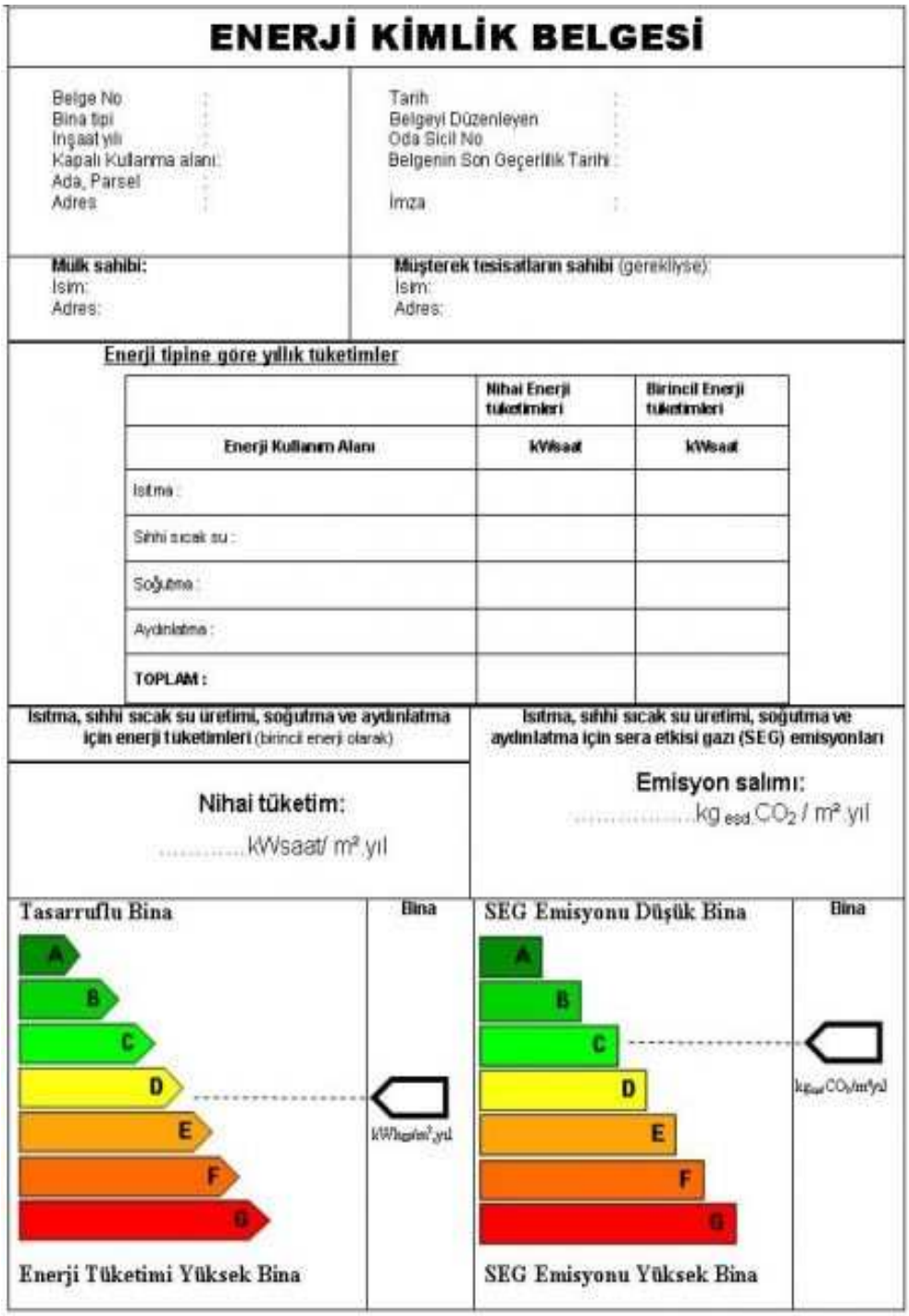

Figure 4.9 : Building Energy Performance Certificate in Turkey

4.2.4 Education and Research

Turkey's educational sector also has a limited but productive investment in green building. The faculty at Istanbul Technical University, now part of the Sustainable Energy Research Group (SERG), has researched energy efficiency and passive conditioning strategies since the 1950s. Their work now includes building

technology research laboratories and pairing with corporate partners such as the Kanyon Mall to research energy modeling techniques.

Turkey's other major technical school, the Middle Eastern Technical University, has also long inquired into sustainable design. Students at METU built the Ankara Solar House in 1975, and current research tracks in the Architecture Department include "Architecture and Environment" and "Sustainable Architecture: Green Design, Community Design and Universal Design in Architecture." While the specific research inquiries may be mixed, it is clear that the rhetoric and agenda of sustainable architecture are being incorporated into some of Turkey's highest academic institutions.

4.3 CASE STUDY: Erzurum Shopping Center (An Analysis of Turkey's First Breeam Certified Building)

Erzurum Shopping Center is the first green shopping centre and **the first building in Turkey to be certified by BREEAM**, which received a **"Very Good"** rating and will also applied for a BREEAM in Use certificate, to ensure that the environmental performance of the building is continuously improved.

The centre was developed by REDEVCO which is a Dutch-based real estate development company. And, it will partly generate its own on-site energy. Waste heat will be used for heating and cooling, resulting in lower CO2 emissions than other shopping centers in Turkey.

In this part of the section, after an overview of Erzurum Shopping Center's general information, Breeam assessment is analyzed to underline system's framework to find out the benefits and obstacles for Turkey and it also concludes with the findings of case study to determine the requirements and the pathways for adopting a national green building rating system.

4.3.1 General Information About the Project

Redevco Turkey has developed Erzurum Shopping Centre in the centre of Erzurum. Erzurum province is the largest province at a population of 785.000 in Eastern Anatolia and functions as the central administrative district for the whole of eastern Turkey (Figure 4.10).

With its longest high volumes of winter tourism, and these are likely to increase as Erzurum prepares to host the 2011 Universiade Winter Olympics. The Erzurum Shopping Centre is opened on 21st of October 2009.

Figure 4.10 : Erzurum province in Turkey (source : Url-11)

- **Location and Accessibility :**

Erzurum Shopping Centre is situated about 1 km south of the city centre (Figure 4.11). The site is close to both Ataturk University and districts of dense residential development and to Palandoken with an easy access from airport (Figure 4.12).

Figure 4.11 : Location of Erzurum Shopping Centre (1)

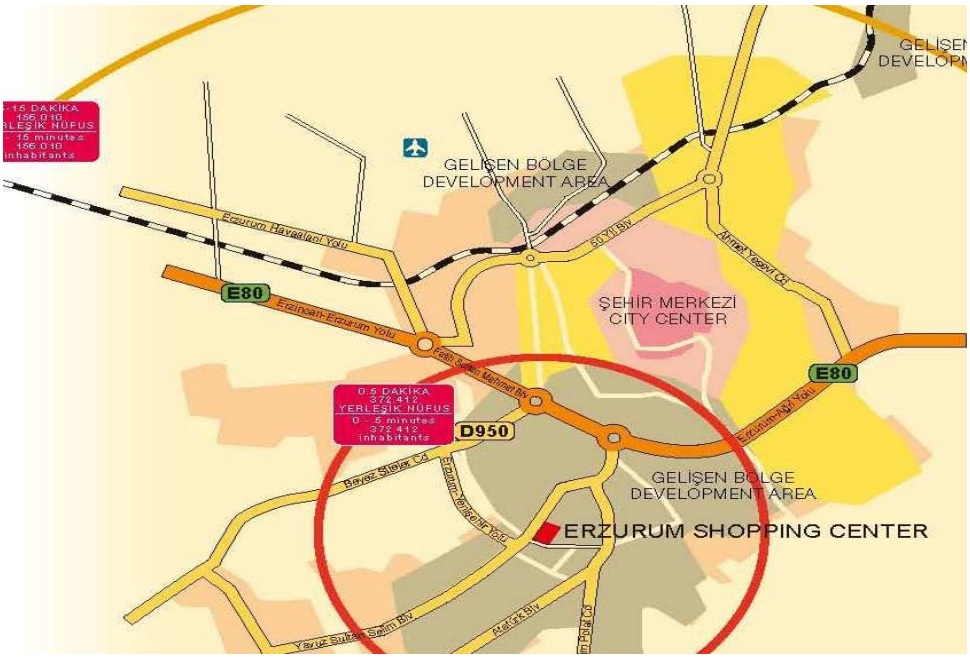

Figure 4.12 : Location of Erzurum Shopping Centre (2)

The site is on the main Yavuz Sultan Selim Boulevade and adjacent the Slakzade Mosque (Figure 4.13). It is within walking distance of nearby residential areas, while neighbor provinces can easily reach the shopping centre by car or public transport. It is also on a key bus route serving the city centre and railway with bus stops immediately alongside the mall. The city is also served by international road links and has an airpot.

Figure 4.13: Accessibility of Erzurum Shopping Centre

The site was previously undeveloped but used as storage area for building materials and for the repair of motor vehicles. It had been earmarked by the municipality for a major retail development

Figure 4.14 : Land View of Erzurum Shopping Centre

- **Building Details, Type and Size :**

The Erzurum concept was designed by Redevconcepts, the in-house concept team of REDEVCO, and incorporates new installations to meet the latest energy efficiency requirements. The architecture was designed jointly by Chapman Taylor Architects and Redevconcepts.

Figure 4.15: An inside view from Erzurum Shopping Centre

Two entrances along the main road give access to three levels of retail on top of two levels of parking. In the interior, natural stone, wood and steel have been used. Three squares, each with their own identity and colour, have been created within the centre. The biggest of these holds the food court, partly divided from the outside by glass windows offering a panoramic view (Figure 4.15).

It includes two levels of basement car parking, a basement level hypermarket, ground and first floor general retail and a top floor with centre management offices and a multi – screen cinema .

The Erzurum Shopping centre houses the region's first and biggest hypermarket Carrefour, the biggest cinema complex Cinebonus, and the biggest electronic market Teknosa as an anchor. And some other key tenants are; Boyner Department Store, LC Waikiki, Nike, Intersport, Koton, Benetton, Playhouse and Burger King.

Enclosed parking facilities, directly under the shopping centre and equipped with the latest features, offer 1,200 parking spaces. Total floor area is 48,000 m2 and the gross leasable area is 32,000 m2 (Table 4.1).

Table 4.1: Size of Erzurum Shopping centre (source : Url-11)

Gross Leasable Area	**32,000 sqm**
Retail	20,500 sqm
Food Court	1,200 sqm
Carrefour	8,000 sqm
Cinebonus	2,300 sqm
Retail Units	**130 units**
Parking	**1200 plc**

Total investment cost of Erzurum Shopping Centre is 70.000.000 € (euro) and, according to the explanation of İlker Aydın from Redevco Turkey, green premium cost of the project is totally 3.200.000 euro.

It is also parallel to the ratio which is given in the second section of the thesis in part of financial benefits.

4.3.2 Building Performance (BREEAM)

The Erzurum Shopping Centre, Turkey for Redevco has been commissioned to carry out a **BREEAM Retail (2006*)***, Design and Procurement assessment. Assessment categories are **Management, Health and Wellbeing, Energy & Transport, Water, Materials and Waste, Land Use and Ecology, Pollution**. According to this, an environmental weighting is applied to the scores achieved under each category , as shown in below (Table 4.2), in order to calculate the final BREEAM score for Erzurum Shopping Centre.

Table 4.2: BREEAM Retail 2006 Score Calculation Weightings for Erzurum Shopping centre (source : Url-11)

ISSUE CATEGORY	ISSUE WEIGHTING
Management	0.15
Health and Wellbeing	0.15
Energy	-
Transport	-
Energy & Transport	0.25
Water	0.05
Materials and Waste	0.10
Land Use and Ecology	0.15
Pollution	0.15

The weighting factors have been derived from consensus based research with various groups such as government, material suppliers and lobbyists. The research was carried out by BREEM to establish the relative importance of each environmental

issue. The BREEAM rating bands used by BREEAM 2006 Retail Scheme, for Erzurum Shopping Centre, are as follows (Table 4.3) :

Table 4.3: BREEAM Retail 2006 Certification Ratings for Erzurum Shopping centre (source : Url-11)

BREEAM Rating	
Unclassified	<25
Pass	≥25 - <40
Good	≥40 - <55
Very Good	≥55 - <70
Excellent	≥70

4.3.2.1 Score Calculations

Erzurum Shopping Centre currently achieves a score of **55.07%** against the BREEAM Criteria (**BREEAM Retail 2006**, Design and Procurement assessment).

This translates into an overall BREEAM rating of **Very Good**.

Table 4.4 below illustrates how the BREEAM score has been calculated .

Table 4.4: BREEAM Score Calculation and Score for Erzurum Shopping Centre

Overall Credit Allocation	**Environmental Weighting**	**Percentage section credits achieved**	**Overall Weighted Percentage**
Management	15%	50,00%	**7,50%**
Health & Wellbeing	15%	81,82%	**12,27%**
Energy	-	64,00%	-
Transport	-	66,67%	**-**
Energy & Transport	25%	64,52%	**16,13%**

Table 4.4: (continued) BREEAM Score Calculation and Score for Erzurum Shopping Centre

Overall Credit Allocation	Environmental Weighting	Percentage section credits achieved	Overall Weighted Percentage
Materials	10%	33,33%	**3,33%**
Land Use & Ecology	15%	33,33%	**5,00%**
Pollution	15%	50,00%	**7,50%**
		Totals	**55,07%**

In Breeam, as it is mentioned in the previous section of the thesis, score calculations are made according to issue weightings (environmental weightings) for each category and from here, overall weightings are calculated to reach the final score (totals of overall weighted percentage for each category).

Figure 4.16 below shows the overall assessment performance clearly :

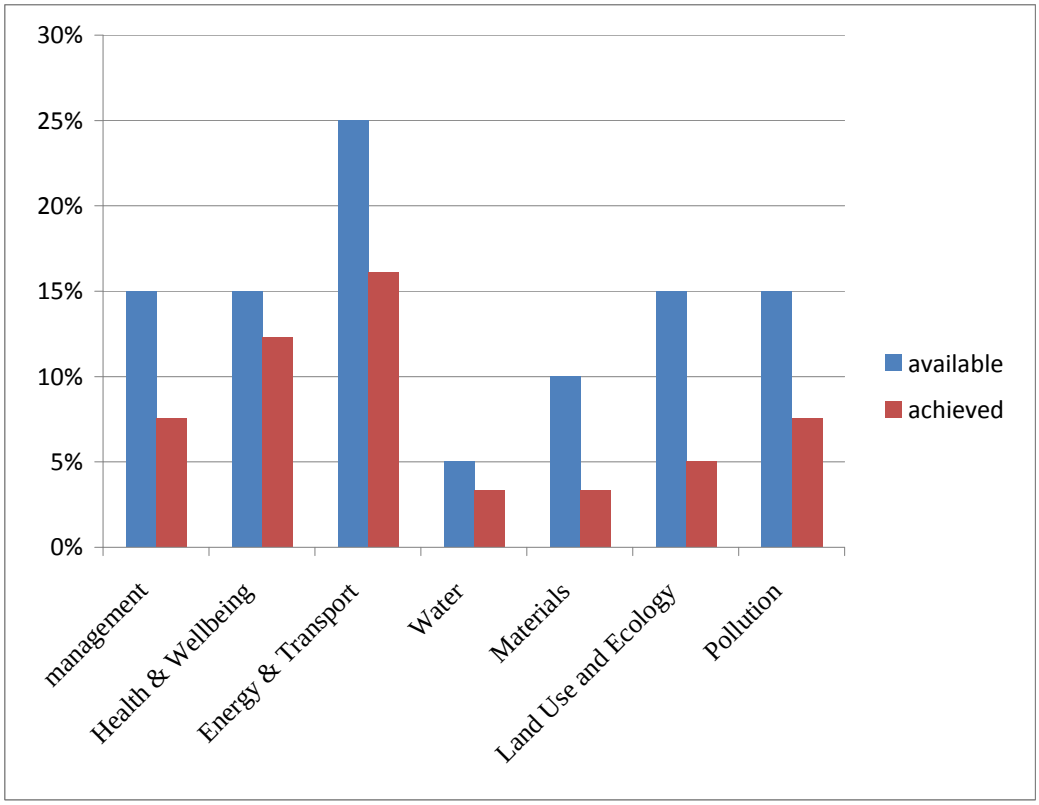

Figure 4.16 : Overall Assessment Performance for Erzurum Shopping Centre

4.3.2.2 Detailed Assessment Information

In every issue category, there are different subheadings related to main issue aim. And every subheading has different credits to achive. The following part summarizes both achieved and not achieved credits in general with subheadings and gives the each issue's score for Erzurum Shopping Center.

In **Appendix.1,** only the achieved credit requirements and the information that has been provided related with Erzurum Shopping Centre against each credit to allow the appropriate number of credits to be awarded is given in**,** to support and analyze the ability of implement for a BREEAM case option where there is not a national green building system as it is given in the third section's final evaluation.

At the same time, BREEAM detailed assessment information disentangle the market-based and competitive nature of the systems from the roles these systems may eventually play in the development of a national green building system and regulating standards.

- **Management :**

Management has **9 subheadings** which are Commissioning, Considerate Constructors, Construction Site Impacts, Environmental Responsibility, Building User Guide, Building User Education, Environmental Policy, Environmental Purchasing Policy, Environmental Management System.

In Management, there are **16 credits available and 8 credits have been achieved at a 50% score** (Table 4.5).

Table 4.5: Management Assessment for Erzurum Shopping Centre

Management	**Credits available**	**Credits achieved**
M1 Commissioning	2	2
M4 Considerate Constructors	2	0
M5 Construction Site Impacts	4	2

Table 4.5: (continued) Management Assessment for Erzurum Shopping Centre

Management		Credits available	Credits achieved
M7	Environmental Responsibility	1	1
M12	Building User Guide	1	1
M13	Building User Education	1	1
M18	Environmental Policy	1	1
M19	Environmental Purchasing Policy	1	0
M22	Environmental Management System	2	0
	Total	**15**	**8**

- **Health and Wellbeing :**

Health and Wellbeing has **9 subheadings** which are Daylighting, High Frequency Lighting, Internal & External Lighting Levels, Internal Air Pollution, Indoor Air Quality, Ventilation Rates, Thermal Comfort, Microbial Contamination, Office Space.

In Health and Wellbeing, there are **11 credits available** and **9 credits have been achieved at a 82% score** (Table 4.6)

Table 4.6: Health and Wellbeing Assessment for Erzurum Shopping Centre

Health and Wellbeing		Credits available	Credits achieved
HW1	Daylighting	2	0
HW4	High Frequency Lighting	1	1

Table 4.6: (continued) Health and Wellbeing Assessment for Erzurum Shopping Centre

Health and Wellbeing	Credits available	Credits achieved
HW5 Internal & External Lighting Levels	1	1
HW9 Internal Air Pollution	1	1
HW10 Indoor Air Quality	1	1
HW11 Ventilation Rates	1	1
HW14 Thermal Comfort	1	1
HW16 Microbial Contamination	1	1
HW28 Office Space	2	2
Total	**11**	**9**

- **Energy :**

Energy has **7 subheadings** which are Reduction of CO_2 emissions, Sub Metering of Substantial Energy Uses, Sub Metering of Areas/Tenancy, Building Fabric Performance & Avoidance of Air Infittration, Building Services Whole Life Performance, Lifts and Escalators & Travelling Walkways.

In Energy, there are **25 credits available** and **16 credits have been achieved at a 64% score** (Table 4.7).

Table 4.7: Energy Assessment for Erzurum Shopping Centre

Energy	Credits available	Credits achieved
E1 Reduction of CO_2 emissions	15	9
E2 Sub Metering of Substantial Energy Uses	1	1

Table 4.7: (continued) Energy Assessment for Erzurum Shopping Centre

Energy	Credits available	Credits achieved
E3 Sub Metering of Areas/Tenancy	1	1
E5 Building Fabric Performance & Avoidance of Air Infittration	2	1
E10 Building Services Whole Life Performance	4	2
E17 Lifts	1	1
E18 Escalators & Travelling Walkways	1	1
Total	**25**	**16**

- **Transport :**

Transport has **4 subheadings** which are Provision of Public Transport, Pedestrian Safety, Travel Plan, Travel Information Space.

In Transport, there are **6 credits available** and **4 credits have been achieved at a 67% score** (Table 4.8).

Table 4.8: Transport Assessment for Erzurum Shopping Centre

Transport	Credits available	Credits achieved
T1 Provision of Public Transport	2	2
T6 Pedestrian Safety	1	1
T8 Travel Plan	1	0
T10 Travel Information Space	2	1
Total	**6**	**4**

- **Water :**

Water has **6 subheadings** which are Water Consumption, Water Meter, Major Leak Detection, Sanitary Supply Shut Off, Water Recycling, Irrigation Systems.

In Water, there are **9 credits available** and **6 credits have been achieved at a 67% score** (Table 4.9)

Table 4.9: Water Assessment for Erzurum Shopping Centre

Water	**Credits available**	**Credits achieved**
W1 Water Consumption	3	2
W2 Water Meter	1	1
W3 Major Leak Detection	1	1
W4 Sanitary Supply Shut Off	1	1
W5 Water Recycling	2	0
W6 Irrigation Systems	1	1
Total	**9**	**6**

- **Materials and waste :**

Materials and Waste has **10 subheadings** which are Materials Specification – Major Building Elements, Hard Landscaping & Boundary Protection, Low Impact and Varnishes, Re-use of Building Facade, Re-use of Building Structure, Recycled Aggregates, Responsible Sourcing of Materials, Designing for Robustness, Storage or Retailer Recyclable Waste, Compactor/Baler. In Materials and Waste, there are **15 credits available** and **5 credits** have been achieved at a **33% score** (Table 4.10) .

Table 4.10: Materials and Waste Assessment for Erzurum Shopping Centre

Materials and Waste		**Credits available**	**Credits achieved**
MW1	Materials Specification – Major Building Elements	4	0
MW2	Hard Landscaping & Boundary Protection	1	1
MW4	Low Impact and Varnishes	1	1
MW5	Re-use of Building Facade	1	0
MW6	Re-use of Building Structure	1	0
MW7	Recycled Aggregates	1	0
MW8	Responsible Sourcing of Materials	3	0
MW10	Designing for Robustness	1	1
MW13	Storage or Retailer Recyclable Waste	1	1
MW16	Compactor/Baler	1	1
	Total	**15**	**5**

- **Land Use and Ecology :**

Land Use and Ecology has **5 subheadings** which are Re – use of Land, Contaminated Land, Ecological Value of Land and Protection of Ecological Features, Impact on Site Ecology and Long Term Impact on Biodiversity.

In Land Use and Ecology, there are **9 credits available** and **3 credits have been achieved at a 33% score** (Table 4.11) .

Table 4.11: Land Use and Ecology Assessment for Erzurum Shopping Centre

Land Use and Ecology	**Credits available**	**Credits achieved**
LE1 Re – use of Land	1	1
LE2 Contaminated Land	1	0
LE3 Ecological Value of Land and Protection of Ecological Features	1	1
LE4 Impact on Site Ecology	5	1
LE6 Long Term Impact on Biodiversity	1	0
Total	**9**	**3**

- **Pollution :**

Pollution has **10 subheadings** which are Refrigerant GWP – building services, Preventing Refrigerant Leaks, Insulant GWP, NOx Emissions of Heating Source, Minimizing Flood Risk, Minimizing Watercourse Pollution, Renewable & Low Emission Energy, Reduction of Night Time Light Pollution, Noise Attenuation, Kitchen Wastewater Filtration.

In Pollution, there are **16 credits available** and **8 credits have been achieved at a 50% score** (Table 4.12).

Table 4.12: Pollution Assessment for Erzurum Shopping Centre

Pollution	**Credits available**	**Credits achieved**
P1 Refrigerant GWP – building services	1	0
P2 Preventing Refrigerant Leaks	2	0
P4 Insulant GWP	1	1

Table 4.12: (continued) Pollution Assessment for Erzurum Shopping Centre

Pollution	Credits available	Credits achieved
P6 NOx Emissions of Heating Source	3	3
P7 Minimizing Flood Risk	2	0
P8 Minimizing Watercourse Pollution	1	1
P11 Renewable & Low Emission Energy	3	1
P12 Reduction of Night Time Light Pollution	1	0
P13 Noise Attenuation	1	1
P14 Kitchen Wastewater Filtration	1	1
Total	**16**	**8**

4.3.3 Conclusion of Findings

It is obviously seen in the case of Erzurum Shopping Center, BREEAM is having an holistic approach to green building in order to achieve scores from a large scale of issues like management, land use, ecology or like pollution while scoring energy efficiency and materials although it is important, not the only focus of the system.

As we can analysis in this case study; project is getting high scores from energy and transport, health and wellbeing and water subheadings while it is getting low scores from management, materials, land use & ecology and pollution, parallel to lack of green building materials which is standardized globally without causing GWP, for example transport based, or ecological issues may not be solved locally, score rating even it is a very good rating at overall.

And also, national green building standards are very important in adopting or implementing BREEAM rating system according to national strategies instead of using ASHRAE or CISBE etc. standards usually hard to implement and checklists, for example like ASHRAE in energy credits and CISBE in transport credits **(see Appendix.1)**.

As an other important point out that we can analyze in this case study is setting up BREEAM standards for every new countries or projects each time is a seriously huge undertaking, and this can be also risky to achieve a high score at BREEAM when it is essential to look at the credits list as early as possible even BREEAM is streamlining the system to make it more efficient by standardizing elements rather than starting from scratch each time. It is clearly very important that this process is managed well to ensure that objectives for environmental performance are implemented and evaluated throughout the design and construction of a building.

The case of Erzurum Shopping Center has highlighted the structure and key elements of green building rating systems. It has shown the importance of assessment to determine the depth of sustainability achieved in a project, and that without assessment, initiatives and individual projects may achieve only minimal or shallow improvements.

It also gives an assessment of the assessment system itself. This has shown that while many of the issues and criteria for green building and construction are relevant globally, there are often local or regional situations that necessitate specific requirements.

Evidently, BREEAM International methodology has the potential to be more relevant to local needs, resulting in a more appropriate design and a system that is easier to make successful implements.

4.3.4 Benefits and Obstacles for Turkey

Breeam system responds to a tension between the desire for objective, scientifically rigorous and stringent performance criteria with the desire for practical, transparent, simple to understand criteria that ask the industry to respond to manageable step changes in practice. Some major benefits of Breeam :

- It represent an ‘industry standard’ of what constitutes a green building taking into account both the desire to improve building performance while recognizing issues of cost and practicality.
- It gives a focus to green building practice. Where as design guidelines provide a broader range of issues, assessment methods give structure and priority, and as such provide greater strategic advice to the design team. The

structure and organization ofenvironmental knowledge is proving to be as important as the individual elements.

- It provides summaries of building performance that can be used to communicate to stakeholders. Here, the method by which the results are depicted has a direct bearing on how various performance indicators are used and understood – and by whom.
- It drives innovation regarding sustainability issues within the construction industry, by using rating system encompasses an umbrella of issues which might otherwise be individually dropped or missed.

As any innovation matures and moves through from the early adopters to the early majority, the price of implementing it falls, in turn stimulating more growth (Figure 4.17)

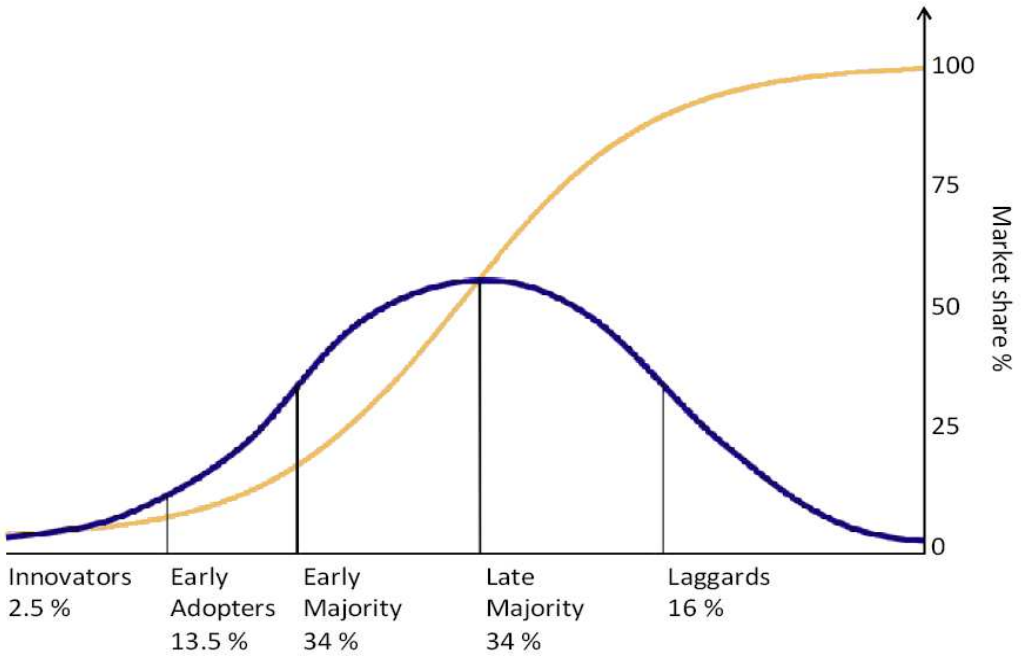

Figure 4.17 : Adopting and implementing Relation
(source:http://upload.wikimedia.org/wikipedia/commons/0/0f/Diffusionofideas.PNG)

On the other hand, there are some obstacles that relate mainly to lack of understanding and awareness of the requirements of green building and the ability to create an integrated and holistic approach.

Although, depth of sustainability achieved is dependent on, and dictated by, issues associated with urban form and availability of materials.

At this point , it is important to have national strategies as legislatives in preventing market – based subjective approaches can be risky for a real green impact.

But also, national green building standards as regulatories are very important in adopting or implementing BREEAM rating system according to national strategies instead of using ASHRAE or CISBE etc. standards usually hard to implement and checklists (Figure 4.18).

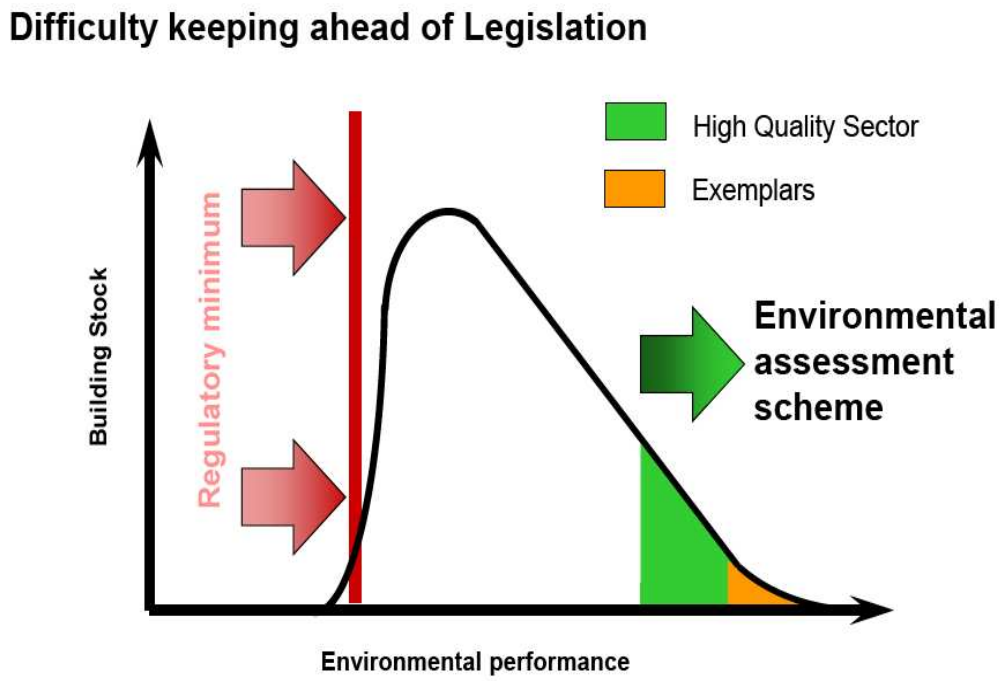

Figure 4.18 : Legislations examplar for Turkey

(Source : url-19)

Accreditation schemes need to push the legislative boundaries, keeping ahead of the mass market in order to drive innovation. This is one reason why requiring accreditation as a legislative minimum may be a bad idea. In order for any scheme to retain value, it should be hard to achieve. At the very least there should be exemplar levels to aspire to attain.

4.4 Evaluation

Turkey's green building industry exists in a nexus of market forces national goverments, academia, technology, and politics. Currently, these forces do not equal more than the sum of their parts. Commercial buildings are taking the lead in green building movement, but they are not enough to make a real impact for reducing

GHGs. At this point, certification systems like BREEAM, even only cover a small portion of the market but play a vital role in making a real green impact..

Government also needs to raise the bar through regulations improvement more globally. Indeed, new regulatory frameworks will help to change energy efficiency level but, it only focuses one or two aspects of green building development, primarily energy efficiency.

Finally, BREEAM can be a benefical and helpful tool in transition period and successful model as a national green building rating system for Turkey to employ when starting a national green building systems. As inspiration, motivation, and reassurance, and also as guidance frameworks for our own local strategy to achieve a truly sustainability outcome.

5. CONCLUSIONS AND RECOMMENDATIONS

This thesis has been written to give the reader an understanding of the green building to determine what is required to achieve substantial steps towards sustainability in construction and real estate sector. While there has been an overview of Turkey and a focus on case of Erzurum Shopping Centre as the first BREEAM certified green building in Turkey, the criteria and strategies are globally relevant and applicable as a guiding framework. This conclusion will firstly give a synopsis of what was determined throughout this thesis, and secondly what would be required for implementation green rating systems like BREEAM in period of transition and pathways for adopting a national green building rating system.

A green building is one whose structure is designed, built, and operated in such a way that the negative impact to human health and the environment will be reduced. This includes resources used during construction and operation of the building once it is completed and it is the best way to move forward in construction sector with its multiple benefits for real estate developers.

The real estate sector is increasingly aware of its potential in reducing global energy consumption and greenhouse gas emissions. There are numerous benefits of green building in financial parts including economic value, both in terms of rent and in terms of price. Moreover, distinct groups of corporate tenants now prefer “green” space over conventional space. Despite this rapid growth and an estimated value of $ 7.4 billion in 2005, green building still remains a niche market, with only 2% market share in 2005 (NBN 2006).

Green building is the best way to move forward in construction sector with its multiple benefits as real estate developers while they may ignore them in favor of development as usual sometimes.

This recalcitrance systems, in part, from a lack of willingness to change, and because many markets are not demanding that the real estate industry change. The problem comes down to lack of knowledge. Most people are unaware that green building

standards exist, and they do not understand why they are important, or which standards are superior to others.

Compounding these problems are the lack of a global definition of what truly constitutes a green building, and the lack of a global valuation system to measure accurately a green building's performance.

These drawbacks, however, are only slowing not stopping the advance and growing importance of green building around the world. More and more users from office tenants to homebuyers are demanding buildings that meet basic sustainable standards. More and more cities, states, and national governments are mandating basic green standards. Real estate markets now are rewarding green buildings with higher rents and sales prices.

A segment of investor and tenant market are demanding green buildings but, there no basis to make objective investment or leasing decisions. At this point, the need and the opportunity for real estate sector is :

- Green Building rating systems can answer this need
- They can pull the market towards high performance without subsides.

But, for investors and developers to make well-informed decisions regarding investments in green building, more research is needed. Standardized ratings on buildings' quality and a broader adoption of green rating systems would help these efforts as an area where change seems easy and cost-effective is in green building rating systems. İn this thesis, it is also provided to enhance the awareness of the systems and determined the pathways to move forward for real estate developers and other stakeholders.

Green building rating systems and their assessments, which is based on green building standards, are one of the voluntary solutions to define the way. Green building involves the consideration of many issues, including land use, site impacts, indoor environment, energy and water use, lifecycle impacts of building materials, and solid waste.

The green building rating systems themselves are a problem. Some of them are not rigorous enough, others are too complicated. Similarly, many supposed green

building rating systems focus solely on one or two aspects of green building development, primarily energy efficiency.

These rating systems enhance the environmental awareness of building practices and provide fundamental direction for the building industry to move toward environmental protection and the achievement of sustainability. They provide a way of showing that a building has been successful in meeting an expected level of performance in various declared criteria.

Their adoption and promotion has had a major contribution to creating a market demand for green buildings and has significantly shifted the public's awareness and perceptions of what building quality is. As with any voluntary and independent rating system, it is important to disentangle the market-based and competitive nature of the systems from the roles these systems may eventually play in the development of public policy or a national standard. On an even broader societal level, green building can enhance our national security by reducing our country's dependence on fossil fuel imports, for example.

Rating the environmental performance of a building is necessary to ensure that its green credentials incorporate both the visible and invisible elements that make it 'green'. Visible green methods, sometimes described as 'eco-bling', such as photovoltaics, are clearly evident on a building; however, invisible methods like energy efficiency are often more important and can only be identified and recorded by rating or certification.

Worldwide, a variety of green building rating systems have been developed around environmental and energy impacts of buildings. Many countries have either already adopted the green building guidelines or are in the process of adopting them. When applying a green approach to a project, it is generally preferable to use the local system. But, where there is not a national green building rating system like countries Turkey, both LEED US and BREEAM International claim to be usable anywhere in the world.

BREEAM and LEED assess buildings against a wide range of environmental and sustainability issues covering a number of categories. For each issue, one or more 'credits' are available when specific levels of performance or process are achieved. Overall, the total number of points or credits obtained determines the final LEED or

BREEAM score, which results in a rating, ranging from Pass to Outstanding for BREEAM, and Certified to Platinum for LEED.

Finally, before very long, green building standards will be the norm, not the exception, in many nations around the world. And where there is not a national green rating system, BREEAM International is a serious contender to LEED and quite possibly the better option in achieving greener, high-quality buildings.

Turkey's green building industry exists in a nexus of market forces like national goverments, academia, technology, and politics. Currently, these forces do not equal more than the sum of their parts. Commercial buildings are taking the lead in green movement, but they are not enough to make a real impact for reducing GHGs. Though Turkey's green buildings are more of a presence than ever, incentives are needed to make an average going green.

36% of energy used in Turkey annually is for the buildings. The largest amount of carbon dioxide emissions in Turkey comes from the burning of fossil fuels for buildings. This makes buildings the single highest contributor to the greenhouse gas emissions that cause climate change – as well as locations of some of the most effective opportunities to reduce these emissions.

In order for building industry to reduce CO_2 emissions, we need to build green and retrofit to make existing buildings green. Green building rating systems like BREEAM, only cover a small portion of the market but play a vital role in testing new technologies and promote innovation.

BREEAM International methodology has the potential to be more relevant to local needs, resulting in a more appropriate design and a system that is easier to implement.

As it is obviously seen in the case of Erzurum Shopping Center, BREEAM is having an holistic approach to green building in order to achieve scores from a large scale of issues like management, land use, ecology or like pollution while scoring energy

The case of Erzurum Shopping Center has highlighted the structure and key elements of green building rating systems. It has shown the importance of assessment to determine the depth of sustainability achieved in a project, and that without assessment, initiatives and individual projects may achieve only minimal or shallow improvements. It also gives an assessment of the assessment system itself. This has

shown that while many of the issues and criteria for green building and construction are relevant globally, there are often local or regional situations that necessitate specific requirements.

These rating systems contribute to a more sustainable built environment, but there are critical issues that have emerged:

- Cover a broad array of sustainability factors, they are not able to be fully sustainable without full integration
- Achieving beneficial change, there is currently little understanding of the depth of sustainability that is actually achieved
- Being voluntary initiatives that have no (or very little) mandatory requirements and no mechanism by which to assess or rate the depth or degree of sustainability achieved within projects

In view of these findings, there are a number of observations that can be made about the future development of the sector in Turkey.

Green building systems like BREEAM can be tools for counties to employ when starting their own green building standards. Extensive networks also allows these nations to collect case studies and best practices information for counties may wish to consider for developing green building programs or adopting incentives.

It is suggested the current initiatives that are being implemented are the first steps of what will become more detailed and institutional rating systems as a national rating system for Turkey and would be a useful tool to monitor and evaluate changes in building product, both in terms of delivery and also operation.

But, national strategies are very important in adopting a national rating system according to national standards for regional differences.

Government also needs to raise the bar through standards and codes improvement. Codes application and execution are uneven - any policy initiative should start with a codes component to set the baseline and require jurisdictions to build permit review and inspection infrastructure.

A national green building model code, similar to STANDARD 189 in USA which sponsored by ASHRAE, should be prepared for Turkey according to our own national strategies. In addition to national standards, some counties and other local

governments shall establish their own regionally-specific standards for green building. Some also enact green building legislation, setting minimum standards of resource efficiency, waste output, and indoor environmental quality etc. for all type of buildings.

Furthermore, after setting our national and regional standards and enable with global systems, it shall be also sensitive to which issues are weighting and weight score calculation according to our own green building strategy.

Some major issues which are recommended for Turkey :

- Site sustainability
- Water Use Efficiency
- Energy Efficiency
- Indoor Environmental Quality
- Building's Impact on Atmosphere
- Materials and Resources
- Construction and Plans for Operation

The following recommendations are addressed primarily to Turkey's commercial, institutional, industrial, and multifamily residential construction market. While we have only the power of suggestion at our disposal, this **Action Plan** will lead to further positive activity for sustainable development (Figure 5.1):

i. Conduct peer-reviewed studies of the benefits of green buildings related to human performance, health, and well-being

ii. Enlist the real estate, financial, insurance, and appraisal community to champion a rigorous, peer-reviewed study of the economic and "business case" aspects of sustainable design

iii. Establish a Senior Interagency Green Building Council at the National level

iv. Establish an Institute for Sustainable Development Research, pooling the resources of major universities, the government, and the private

sector to create a unified center for Research & Development and data collection on sustainable design and development

v. Create guidelines for Turkey, and municipalities to implement sustainable design policies, legislation, executive actions, regulations, and incentives

vi. Launch a pilot programs

vii. Building product manufacturers should cooperate with efforts to create green product tools and databases using life cycle assessment

viii. Continue to upgrade the system

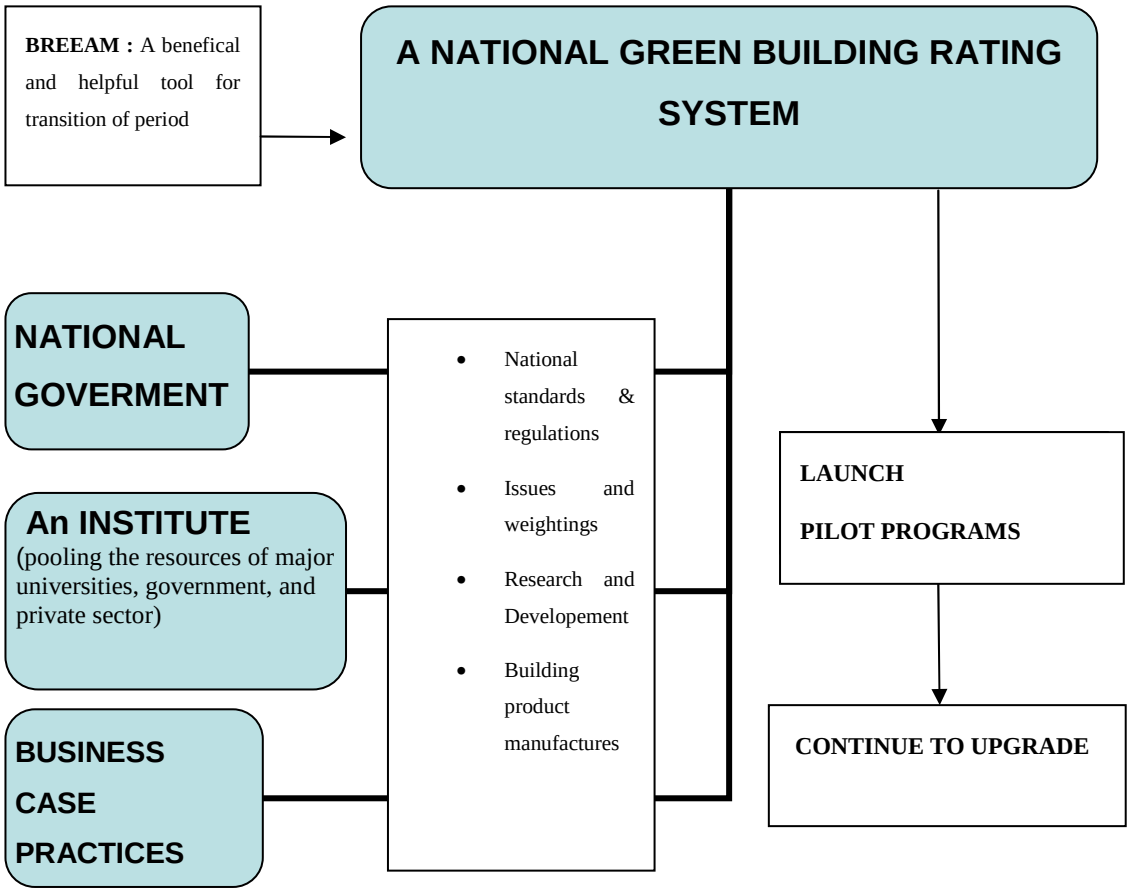

Figure 5.1 : Action Plan for Turkey

As outlined on previous pages, this national system should be explicit in their sustainability objectives and have an integrated framework, which have been incorporated into the sector through a combination of political, industry and community commitment.

It is also suggested that a rating system be incorporated into green building to determine the 'depth of greenness' of individual projects. This would achieve a greater understanding of sustainability issues in the built environment, and would also create a measurable level of achievement that can be used to determine the success of individual projects, as well as the rating system itself.

New strategies or a national rating system that would encompass all the main elements of the sector would require compelling arguments that clearly demonstrate the benefits to be gained. They would also have to demonstrate that the strategy would not adversely effect or impact negatively upon the day-to-day operations of the sector and that any strategies undertaken will enhance the viability of the sector.

It is suggested that government agencies and industry associations need to investigate how to create new, and 'join-up' existing, initiatives and create a national system whereby sector professionals, clients, occupants and users, and the community in general, could gain awareness and a working understanding of green building and construction.

This thesis has provided sufficient critical information to prove the benefits of green building, as well as providing relevant examples of green building rating systems that are being implemented throughout the world. It has also shown the pathways, at both an organizational and process level, by which to implement sustainability initiatives throughout the building and construction sector.

It is suggested that a sustainability strategy that is designed to develop and promote a national green building rating system throughout the sector in Turkey would have specific and very obvious benefits. It would also be the most important manifestation of the sector's acknowledgement of sustainability as the key to human and ecological prosperity. The only impediment to developing green building and construction initiatives is a lack of willingness to commit by key stakeholders.

REFERENCES

Aaras, A., 1998. *Musculoskeletal*, Visual and Psychosocial Stress in VDU Operators Before and After Multidisciplinary Ergonomic Interventions. Applied Ergonomics, pg. 335-354.

Beyer, D., 2002. Sustainable Building and Construction Implementing in Western Australia, *M.sc. thesis*; Murdoch University, Australia.

Blom, I., 2006. Environmental Assessment of Buildings: Bottlenecks in current practices. In proceedings: *Housing in an expanding Europe: Theory, policy, participation and implementation*. 2-6, July 2006; Ljubljana, Slovenia.

Bourdeau L., 1999. *CIB Report* Publication 237 on Agenda 21 on Sustainable Construction, July 1999.

Bruntland, G (ed), 1987. World Commission on Environment and Development (WCED). *Our common future,* Oxford University Press, pg. 43, Oxford.

Calguner, T., 1999. Environmental Impact Assessment and the Urban Planning Crisis in Turkey. *Impact Assessment and Project Appraisal*, Vol. 17, No. 2, pg.165-168.

Carlson, P.O. and Lundgren, J., 2002. Environmental Status of Buildings, new features in the Swedish system for environmental auditing and assessment of building. In proceedings: *Sustainable Building Conference 2002*, Oslo, Norway.

Chaharbaghi, K. and Willis, R., 1999. The Study and Practice of Sustainable Development, *Engineering Management Journal*, Vol.9, No.1, Feb. 1999, pg.41-48.

Cole, R.J., 2005. 'Building environmental methods: redefining intentions', *Building Research &Information*. Vol. 35(5), pg. 455-467.

Cole, R.J., 1998. 'Emerging trends in building environmental methods', *Building Research &Information*. Vol. 26(1), pg. 3-16.

Cole, R. J. and Larsson, N, 2002. *GBTool User Manual*, Green Building Challenge.

Cooper, I., 1999. 'Which focus for building assessment methods: environmental performance or sustainability?', *Building Research & Information.* Vol. 27 (4/5), pg.321-331.

Crawley, D. and Aho, I., 1999. 'Building environmental assessment methods: environmental performance or sustainability?'. *Building Research & Information*. Vol. 27 (4/5), pg.300-308.

Ding, C.K.C., 2008. Sustainable construction: The role of environmental assessment tools, *Journal of Environmental Management*. Vol. 86 (2008), pg. 451-464.

Edwards, B., 2002. *Rough Guide to Sustainability*. RIBA Companies Ltd. London, UK.

Environmental Information Administration (EIA), 2008. EIA Annual Energy Outlook.

Erten, D., Korkmaz, S., Syal, M. and Potbhare, V., 2009. A review of Green Building Movement Timelines in Developed and Developing Countries to Build an International Adoption Framework. *Fifth International Conference on Construction in the 21st Century (CITC-V), "Collaboration and Integration in Engineering, Management and Technology*" May 20-22, 2009, Istanbul, Turkey.

Erten, D., Henderson, K. and , Kobaş, B., 2009. A Review of International Green Building Certifications: Pathways for a National Green Building Certification for Turkey. *Fifth International Conference on Construction in the 21st Century (CITC-V) "Collaboration and Integration in Engineering, Management and Technology"* May 20-22, 2009, Istanbul, Turkey

Feltes, V., 2007. Toward Sustainable Building – Green Building Design and Integration in the Built Environment. *M.sc. thesis;* School of Architecture & Construction Management, Washington State University.

Fisk, W.J., 2000. Health and Productivity Gains from Better Indoor Environments and Their Relationship with Building Energy Efficiency. Indoor Environment Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, Berkeley, California. *Annual Review of Energy and the Environment* 25: 537–66

Forsberg, A. and von Malmberg, F., 2004. Tools for environmental assessment of the built environment, *Building and Environment*. Vol. 39 (2004). Pg.223-228.

Gomes da Silva, V., 2007. 'Sustainability assessment of buildings: Would LEED lead Brazil anywhere?'. In proceedings: *CIB World Building Congress 2007*, Cape Town, South Africa. Published abstracts pg. 2417-2427.

Haapio, A., 2008. Environmental Assessment of Buildings. *Helsinki University of Technology (Dissertation),* Espoo, Finland.

Harrington, L. and Domnics M., 2001. Energy Labeling and Standards Programs Throught The World, *The National Appliance and Equipment Energy Efficiency Committee*, Australia, Version 1.02.

Hawken, P., Lovins A. and Lovins L. H., 1999. *Natural Capitalism: creating the next industrial revolution*. Boston, MA : Little, Brown and Co.

Hepbasli, A., Ulgen, K. and Eke, R., 2004. Solar Energy Applications in Turkey, *Energy Sources*. Vol. 26, No. 6.

Herbert, G., 2001. Local Authorities and Sustainable Development Guidelines on Local Agenda 21, Department of The Environmental and Local.

Kats, G.H., 2003. Green Building Costs and Financial Benefits.

Kats, G., Alevantis L., Berman A., Mills E. and Perlman J., 2003. *The costs and financial benefits of green buildings*. Report to California's Sustainable Building Task Force.

Kohler, N., 1999. The relevance of Green Building Challenge: An observer's perspective, *Building Research & Information*. Vol. 27 (4/5), pg.309-320.

Keskin, T., 2008. Energy Management in the Building Sector : Turkish Experience, *World Energy Council Turkish National Committee*, 2008.

Kibert, C. J., 2008. Sustainable Construction: *Green Building Design and Delivery*, 2nd Edition, Florida.

Koyun, A., 2007. Mediterranean and National Strategies for Sustainable Development, Energy Efficiency and Renewable Energy : *Turkey (National Study), Plan Blue*. Regional Activity Centre, March 2007, Sophia Antipolis.

Lockwood, C., 2007. Green Building Standars Around The World, *Urban Land Magazine*, June 2007, pg.110-114.

Madge, P., 1993. Design, ecology, technology: a historiographical review. *Journal of Design History* 6 (3): pg. 149-166

NBN, 2006. *Green Building Barrels Into the Mainstream Market.* Nation's Building News, March 20, 2006. Published by the National Association of Homebuilders.

Nok, T.A. , 2008 . Elements identification for the labeling of sustainable building – a low rise building, *M.sc. thesis*; University Technology Malaysia.

Rees, W.E., 1989. *Planning for Sustainable Development*: a resource book. Vancouver, B.C., Canada. UBC Centre for Human Settlements.

Roodman, D.M. and Lenssen N., 1995. A building revolution: *how ecology and health concerns are transforming construction*. Worldwatch Paper, 124. Washington, DC: Worldwatch Institute.

Sage, A.P., 1998**.** Risk Management for Sustainable Development, School of Infrastructure Technology & Engineering, *George Mason University.*

Smith, M.T., Fischlein, M., Suh, S. and Huelman P., 2006. A Comparison of the LEED and Green Globes Systems in the US, *University of Minnesota*.

St.John, A., 1992: The Sourcebook for Sustainable Design: *a guide to environmentally responsible building materials and processes*. Boston, MA: Architects for Social Responsibility.

Thompson, J., 2003. Green design: going mainstream? Making the business case is the key to bringing sustainability into the mainstream. *Urban Land Magazine*, 62 (7): pg.10-17.

Url-1 <*http://www.usgbc.com*>, accessed at 29.02.2010.

Url-2 <*http://www. ideaplants.org* >, accessed at 13.11.2009.

Url-3 <*http://www. bdonline.co.uk* >, accessed at 26.02.2010.

Url-4 <*http://www. inhabitat.com* >, accessed at 02.01.2010.

Url-5 <*http://www. sustainability.uark.edu* >, accessed at 15.10.2009.

Url-6 <*http://www. dianhasan.wordpress* >, accessed at 25.10.2009.

Url-7 <*http://www. static.urbarama.com* >, accessed at 10.09.2009.

Url-8 <*http://www. qut.edu.au* >, accessed at 30.03.2010.

Url-9 <*http://www. kerkenes.metu.edu.tr* >, accessed at 17.11.2009.

Url-10 <*http://www. yapi.com.tr* >, accessed at 26.01.2010.

Url-11 <*http://www. redevco.com* >, accessed at 21.03.2010.

Url-12 <*http://www. tekfenoz.com* >, accessed at 29.03.2010.

Url-13 <*http://www. uli.org*>, accessed at 29.04.2010.

Url-14 <*http://www. mtpc.org* >, accessed at 25.03.2010.

Url-15 <*http://www.ukas.com*>, accessed at 23.04.2010.

Url-16 <*http://www.unep.org*>, accessed at 05.03.2010.

Url-17 <*http://www.worldgbc.org*>, accessed at 15.04.2010.

Url-18 <*http://www.epa.gov*>, accessed at 01.12.2009.

Url-19 <*http://www.breeam.org*>, accessed at 08.03.2010.

U.S. Environmental Protection Agency (EPA), 1987. The Total Exposure Assessment Methodology (TEAM) Study.

U.S. Environmental Protection Agency (EPA), 2009. Estimating 2003 Building-Related Construction and Demolition Materials Amounts.

Yates, A., 2001. *Quantifying the business benefits of sustainable buildings:* summary of existing research findings. Project Report # 203995. Watford, UK: Building Research Establishment, Centre for Sustainable Construction.

Yudelson, J., 2008. *The Green Building Revolution*. Washington.Covelo.London: Island Press, 2008.

APPENDICES

APPENDIX A.1 : Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

APPENDIX A.1

Table A.1 : Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
MANAGEMENT CREDITS			
M1 Commissioning	to recognize and encourage an appropriate level of building services commissioning that is carried out in a co – ordinated and comprehensive manner, thus ensuring optimum performance under actual occupancy conditions	There are **2 credits available** in this section; one credit can be awarded where evidence provided demonstrates that an appropriate project team member has been appointed to monitor commissioning on behalf of the client to ensure commissioning will be carried out in line with current best practice. And one other credit can be awarded where evidence provided demonstrates that seasonal commissioning will becarried out in line with current best practice. And one other credit can be awarded where evidence provided demonstrates that seasonal commissioning will be carried out during the first year of occupation	**2 credits are achieved**. It was agreed that a specialist contractor will be appointed to carry out commissioning and this will be carried out in accordance with a recognised code of practice such as ASHRAE. It was also agreed that seasonal commissioning will be carried out. Evidence required - contract document setting out scope of work and standards to be followed
M5 Construction Site Impacts	to recognise and encourage construction sites managed in an environmentally sound manner in terms of resource use, energy consumption, waste management and pollution	There are **4 credits available** in this section; 1st credit can be awarded where evidence provided demonstrates that two or more items listed below achieved and for 2nd credit it is four items and for 3rd credit its is six items and the 4th last one is awarded where the evidence provided that all site timber is responsibly sourced.	**2 credits are achieved**. It was agreed that main contractor is carrying out 4 of the 6 monitoring actions listed in checklist but that unable to comply with the sustainable timber requirement

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
MANAGEMENT CREDITS			
M5 Construction Site Impacts		And the related list is: - Monitor, report and set targets for CO_2 or energy arising from site activities - Monitor, report and set targets for CO_2 or energy arising from transport to from site - Monitor, report and set targets for water consumption arising from the site activities - Monitor construction waste on site - Sort and recycle construction waste Adopt best practice policies in respect of water (ground and surface) pollution on the site	
M7 Environmental Responsibility	to recognize and encourage an individual who can take ownership and responsibility for monitoring and implementing strategies to avoid environmental impacts	There are **1 credit available** in this section; it can be awarded where evidence provided demonstrates that environmental responsibilities have been allocated to an appropriate named individual	**1 credit is achieved.** It was agreed that main contractor will appoint a named person on site with the authority to ensure that the environmental credits being claimed are undertaken by main contractor and subcontractors.
M12 Building User Guide	to recognize and encourage the provision of guidance to enable a building user to understand and operate the building efficiently in line with current good practice and in the manner envisaged by the design team	There are **1 credit available** in this section; it can be awarded where evidence provided demonstrates the provision of a simple guide that covers information relevant to the tenant/occupants and non-technical building manager on the operation and environmental performance of the building	**1 credit is achieved.** It was agreed that a user guide will be produced for facilities manager and tenants that meet the requirements of BREEAM

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
MANAGEMENT CREDITS			
M13 Building User Education	to facilitate the structured and systematic provision of training that enables building users to understand and operate the building efficiently	There is **1 credit available** in this section; it can be awarded where evidence provided demonstrates that training is provided to the building occupants on the appropriate use of building controls and procedures to maintain efficient building operation and minimize operational environmental impacts	**1 credit is achieved.** It was agreed that that this will be undertaken. Details need to be agreed as to how this will relate to a shell and core design and unknown future tenants but will generally follow BREEAM guidance
M18 Environmental Policy	to recognize and encourage the implementation of a formal environmental policy that addresses, and aims to reduce, organizational environmental impacts	There are **1 credit available** in this section; it can be awarded where evidence provided demonstrates the existence and implementation of a formal company (or corporate) environmental policy, which has endorsement from senior company directors	**1 credit is achieved.** Redevco have such policy in place as demonstrated in Business Plan
HEALTH AND WELLBEING CREDITS			
HW4 High Frequency Lighting	to reduce the risk of health problems related to frequency of fluorescent lighting	There is **1 credit available** in this section; it can be awarded where evidence provided demonstrates that high frequency ballasts are installed on all fluorescent lamps	**1 credits is achieved**. It was agreed that that all fluorescent lighting in landlord's areas will have high frequency ballasts
HW5 Internal & External Lighting Levels	to ensure lighting has been designed in line with best practice for suitability and	There is **1 credit available** in this section; it can be awarded where evidence	**1 credits is achieved**. It was agreed that internal and external lighting levels will

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
HEALTH AND WELLBEING CREDITS			
HW5 Internal & External Lighting Levels	visual comfort	provided demonstrates that all internal and external lighting , where relevant, is specified in accordance with the appropriate maintained illuminance levels (in lux)	be in accordance with the set outs
HW9 Internal Air Pollution	to reduce the risk to health associated with poor indoor air quality	There is **1 credit available** in this section; it can be awarded where air intakes serving occupied areas avoid major sources of external pollution and recirculation of exhaust air	**1 credits is achieved**. It was agreed that design will meet BREEAM requirements for minimum distance between any air intake and air exhaust, flue, road or other potential source of air pollution. Evidence in the form of drawings showing the locations of all air inlets, outlets and flues. A drawing showing all the fresh air intakes, exhausts and flues has been provided. This demonstrates that all fresh air intakes are more than 20m from any flues or car parking areas/roads. In all cases, the fresh air intake ductwork has been intentionally extended so as to provide a distance of at least 10m from exhaust air outlets
HW10 Indoor Air Quality	to ensure adequate indoor air quality	There is **1 credit available** in this section; it can be awarded where the evidence provided demonstrates CO_2 levels are monitored and can be regulated in areas with unpredictable occupancy patterns.	**1 credits is achieved**. It was agreed that any large areas (landlord's) where population is likely to vary greatly and unpredictably will utilise CO_2 sensing to increase/decrease fresh air flow rate. This is indicated

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
HEALTH AND WELLBEING CREDITS			
HW10 Indoor Air Quality			on a controls schematic. The air handling units controlled in this way serve both the Mall areas and individual shops units. Manufacturer's details of the CO_2 sensor were also provided
HW11 Ventilation Rates	to recognize the provision of adequate fresh air rates, in order to maintain a healthy indoor environment	There is **1 credit available** in this section; it can be awarded where the evidence provided demonstrates that each space within the development achieves recommended fresh air rates	**1 credits is achieved**. It was agreed that landlord's areas will be supplied with sufficient fresh air to meet the minimum requirements of either CIBSE or ASHRAE standards. Design ventilation are set out in the technical specification and lists all types of areas within the shopping mall. In addition, the fresh air quantity will be controlled by CO_2 sensors which is detailed in HW10
HW14 Thermal Comfort	to encourage the use of design tools to ensure that thermal comfort is achieved	There is **1 credit available** in this section; it can be awarded where thermal comfort levels are assessed at design stage, this is used to evulate appropriate servicing options, and appropriate thermal control levels are achieved	**1 credits is achieved**. Dynamic thermal modelling has been carried out to assist in the design of the building with respect to achieving acceptable levels of thermal comfort as specified by CIBSE or ASHRAE. Extensive thermal modeling has been carried out using a fully dynamic thermal simulation tool to assess the resulting thermal comfort conditions. This is described in a report written by Ecofys:

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
HEALTH AND WELLBEING CREDITS			
HW14 Thermal Comfort			The report states that ' The object of this study is a new shopping mall in Erzurum in Turkey. The study describes the simulation model of shopping mall and its results in order to identify opportunities for energy saving, problems related to the interior climate and or reduce investment costs related to installations for climate control'. The study was carried out at a concept stage and has been assessed thermal comfort in terms of both Operative Temperature and indicating where improvements shoul be made. This included the impact of solar radiation through the rooflights on thermal comfort and energy consumption and recommendations for reducing solar gain. Recommendations also included the addition of thermal insulation to the floor slab above the car park to improve thermal comfort. Am email from Ecofys confirms that these recommendations have been accepted by the design team and will be included in the development. Comfort indices have been determined based on anticipated installed capacity and type of HVAC systems. These demonstrate the acceptable temperatures will be achieved based on design criteria for shopping malls (20-24 'C). The model comprises a 3D representation including form, construction, orientation, and internal layout. Local hourly data was used. The consultant who carried out the study has confirmed that the software used is Energy Plus (as required by LEED for energy assessments) with a user front end by DesignBuilder USA

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
HEALTH AND WELLBEING CREDITS			
HW16 Microbial Contamination	to ensure the building services are designed and maintained to avoid risk of legionellosis	There is **1 credit available** in this section; it can be awarded where the evidence provided demonstrates that the risk of waterborne and airborne legionalle contamination has been minimized	**1 credits is achieved**. It was agreed that HVAC and water installations will be designed in accordance with either CIBSE or ASHRAE with regards the prevention of spread of legionella and that there is no humidification
HW18 Office Space	to recognize steps taken to provide a good working environment in the office areas within the development	There are up to **2 credit available** in this section; it can be awarded as where information provided demonstrates that office space within the development achieves best practice in terms of occupant comfort and control	**2 credits is achieved**. It was agreed that all normally occupied office space provided in Landlord's areas will have a window and be adequately daylight, be equipped with thermal and lighting control
ENERGY CREDITS			
E1 Reduction of CO_2 emissions	to recognize and encourage buildings that are designed to minimize the CO_2 emissions associated with their operational energy consumption	There are **15 credit available** in this section; it can be awarded based on either : 1) a percentage improvement on CO_2 emissions as set out in ASHRAE standard 90-1/2004 or 2) the completion of a specific check list	**9 credits is achieved**. It was agreed that 9 credits would be initially allocated based on estimated CO_2 savings of 27%. No calculations have been produced based on ASHRAE. The checklist has been completed and checked by assessor. This indicates that a total of 9 credits should be awarded - U values are lower than standard - Commitment to limiting Air Permeability to 7.5 m3/h m2 - BMS controls central HVAC

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
ENERGY CREDITS			
E1 Reduction of CO_2 emissions			plant and monitors all local plant and zonal temperature, raising alarms on out of range. In addition, lighting controls meet requirements set out in checklist. Central gas-fired boilers have sequence control providing LTHW to individually controlled zonal air handling plants as set out in checklist - More than 80% of general internal lighting better than 70 lamp-lumens circuit Watt (average is 74 L/W) - Seasonal Efficiency of space heating is at least 90% - Inverter control, variable speed pumps are to be used Specific Fan Power less than 2W/L/s (average is 1.87 W/L/s for whole development)
E2 Sub Metering of Substantial Energy Uses	to recognize and encourage the provision of energy sub-metering to facilitate monitoring of energy use	There is **1 credit available** in this section; it can be awarded as where evidence is provided to demonstrate the provision of direct sub-metering to facilitate monitoring of energy use.	**credits is achieved**. It was agreed that will be metering major energy uses in Landlord's areas. This will include all sources of energy used by HVAC plant, lifts, escalators and lighting. Electrical consumption is the biggest contributor of CO_2 emissions arising from buildings. In successfully managing energy consumption it is important that sufficient data is available to managers to allow them to monitor consumption and compare this

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
ENERGY CREDITS			
E2 Sub Metering of Substantial Energy Uses			with historical data. Sub metering allows managers and tenants to establish major uses and where possible alter operational procedures to minimize consumption.
E3 Sub Metering of Areas/Tenancy	to recognize and encourage the provision of energy sub-metering to facilitate energy monitoring by tenant or end user	There is **1 credit available** in this section; it can be awarded as where evidence provided to demonstrates sub-metering of energy use by tenancy/area is installed within the building.	**1 credits is achieved**. It was agreed that all tenants will be metered separately by the BMS. This includes all heating and cooling used and all lighting/small power
E5 Building Fabric Performance & Avoidance of Air Infittration	to ensure that the building is designed and constructed to maximize building fabric performance and minimize unnecessary air infiltration	There are **2 credit available** in this section; it can be awarded as where evidence is provided to demonstrate that goods loading/unloading and warehouse storage areas have been designed and detailed to ensure optimum building fabric performance and to minimize unnecessary air infiltration	**1 credits is achieved**. This relates only to loading bays and goods storage areas. Five of ten measures is incorporated in the checklist that indicates: - External doors are at basement level and protected from prevailing wind by building structure. - Good doors will be insulated - Vents and dampers are to be draught sealed - Partitioning between unloading and general storage areas - Personal doors adjacent good doors
E10 Building Services Whole Life Performance	to encourage the selection of viable options for the main building services on the	There are **4 credit available** in this section; it can be awarded where	**2 credits is achieved**. A spreadsheet has been provided that assesses the life cycle costs of the heating system

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
ENERGY CREDITS			
E10 Building Services Whole Life Performance	basis of their CO_2 emissions over the course of the building's life cycle	evidence provided demonstrates that the project team has carried out quantitative analysis of the cycle energy consumption for at least two viable design options for each of the following services, and they have specified the option that has the lower CO_2 emissions over a 60 year building life cycle: - One credit available for general lighting (fittings, control gear, lighting controls) - One credit available for heating and hot water (boilers, distribution systems, controls) - One credit available for mechanical ventilation (system & controls) - One credit available for air conditioning.	and air conditioning system. This includes use of a CCHP system. The results of these LCAs have been used to select the heating and cooling systems based on minimum energy and CO_2 emissions. This has been confirmed by Redevco by means of a letter and copies of meetings. Evidence in the form of the spreadsheet and letter stating that results of analysis have been incorporated in the design
E17 Lifts	to encourage the specification of energy efficient transportation systems	There is **1 credit available** in this section; it can be awarded where evidence provided demonstrates that the assessed developments passenger and or goods lifts match motor output to passenger demand and returns excess energy to the grid or to meet other on site demand	**1 credits is achieved**. Evidence has been provided of the type of lift system proposed. This utilities an AC gearless system controlled by a frequency inverter to control motor output power. The system is known as Kone Ecodesic. Manufacturer's data provided and this system was adopted. This is a low-rise application (max.4 floors) so that generative breaking is not considered appropriate. It was agreed that variable voltage supply will be used.

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
ENERGY CREDITS			
E18 Escalators & Travelling Walkways	to encourage the specification of energy efficient transportation systems	There is **1 credit available** in this section; it can be awarded where evidence provided demonstrates that escalators avoid unnecessary operation when there are no passengers, there by minimizing energy consumption	**1 credits is achieved**. It was agreed that escalators will be automatically controlled by sensors that will ensure that these operate only where there are passengers, based on actual demand and incorporate time control so as to reduce energy consumption
TRANSPORT CREDITS			
T1 Provision of Public Transport	to recognize and encourage the selection of sites served by good public transport facilities	There are **2 credit available** in this section; one credit can be awarded as where good access is available to and from public transport networks for commuting and the other one credit can be awarded where there is good access to and from public transport networks for business travel.	**2 credits is achieved**. The shopping center is on a main bus route that provides links to both local urban centres and major transport hubs. Several bus routes stop at the shopping mall. These run from 7am until 11pm at various frequencies , during these hours buses linking to local urban centres including city centre run more frequently than every 15 minutes and to the railway station more frequently than every 30 minutes. It was agreed that frequencies suggested by BREEAM are acceptable and that these could be met for this project by bus services. Both credits are achieved
T6 Pedestrian Safety	to recognise and encourage the provision of safe and secure pedestrian and cycle access routes.	There are **1 credit available** in this section; one credit can be awarded as where evidence provided demonstrates that pedestrian routes form a direct route onto and off the site.	**1 credits is achieved**. The shopping center exits are onto the street maintained by the municipality and outside the control of the developer. The complex contains parking areas. These have been designed to provide safe pedestrian routes to the shops incorporating clearly identified and signed pedestrian paths with adequate standards of lighting (CIBSE compliant). Delivery areas do not infringe on the public car park

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
TRANSPORT CREDITS			
T10 Travel Information Space	to encourage building users/visitors/customers to maximise the use of public transport for travel by providing up-to-date information on local public transport routes and timetables.	There are **2 credit available** in this section; it can be awarded where evidence provided demonstrates that there is a dedicated space within the development for the provision of up-to-date public transport information	**1 credits is achieved**. It was agreed with the developer that a static public information space for travel information was provided at the main entrance/exit to the street as part of the general information desk. It was decided that a live information board was not feasible to achieve second credit
WATER CREDITS			
W1 Water Consumption	to minimize the consumption of potable water in sanitary applications	There are **3 credits available** in this section; up to two credits it can be awarded where evidence provided demonstrates that WCs are designed to minimize the consumption of potable water. The other one credit can be awarded where evidence provided demonstrates that other sanitary facilities are designed to minimize the consumption of potable water	**2 credits are achieved**. It was agreed that all Landlord's WCs will be 6/4L dual flush, all wash hand basin taps have auto-off, all urinals have proximity detection control of flushing and all showers are less than 9L/minute. This gives 2 out of three credits
W2 Water Meter	to ensure water consumption can be monitored and managed and therefore encourage reductions in water consumption	There is **1 credits available** in this section; up to two credits it can be awarded where evidence provided demonstrates that a water meter with a pulsed out put will be installed on the mains supply to each building	**1 credit is achieved**. A water meter with pulsed output will be installed on each of the dual incoming mains potable water pipes to the complex. In addition, water meters will be installed to each of the follwoning tenancy areas: small shops, big shops, restaurants, fast foods, hypermarket. This meters will be monitored by the BMS

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
WATER CREDITS			
W3 Major Leak Detection	to reduce the impact of major water leaks	There is **1 credit available** in this section; it can be awarded where evidence provided demonstrates that a leak detection system is specified or installed	**1 credit is achieved**. It was agreed that the pulsed meter(s) will be connected to BMS so that abnormal consumption can be used to raise an alarm.
W4 Sanitary Supply Shut Off	to reduce the risk of minor leaks in toilet areas	There is **1 credit available** in this section; it can be awarded where evidence provided demonstrates that proximity detection shut off is provided to the water supply to all urinals and WCs.	**credit is achieved**. It was agreed that all toilet blocks would incorporate a solenoid valve on the cold water supply activated by a presence detector to allow water to be shut off when not required
W6 Irrigation Systems	to reduce the consumption of potable water for plant and landscape irrigation	There is **1 credit available** in this section; it can be awarded where evidence provided demonstrates that low-water irrigation systems are specified/installed or where planting and landscaping is irrigated via rainwater or reclaimed water	**1 credit is achieved**. It was agreed that rainwater is to be collected and used for irrigation
MATERIALS AND WASTE CREDITS			
MW2 Hard Landscaping & Boundary Protection	to recognize and encourage the specification of materials for boundary protection and external hard surfaces that have a low environmental impact, taking account of the full life cycle of materials use	There is **1 credit available** in this section; can be awarded where evidence provided demonstrates that at least 80% of the combined area of external hard landscaping and boundary protection specifications achieve an A rating, as defined by the Green Guide to Specification.	**1 credit is achieved**. There is no hard landscaping on this project. Evidence in the form of a landscape working drawing. So credit awarded. It was agreed that all Landlord's WCs will be 6/4L dual flush, all wash hand basin taps have auto-off, all urinals have

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
MATERIALS AND WASTE CREDITS			
MW2 Hard Landscaping & Boundary Protection			o proximity detection control of flushing and all showers are less than 9L/minute. This gives 2 out of three credits.
MW4 Low Impact and Varnishes	to recognize and encourage the use of paints and varnishes that have a lower embodied environmental impact	There is **1 credit available** in this section; can be awarded where evidence provided demonstrates that paints and varnishes used for internal decoration and durability have a low environmental impact	**1 credit is achieved**. It was agreed with the design team that only paints and varnishes that have an A rating will be used. The materials specification states that water – based acrylic paints will be used
MW10 Designing for Robustness	to recognize and encourage the protection of exposed parts of the building and landscaping to avoid the need for frequent replacement	There is **1 credit available** in this section; can be awarded where evidence provided demonstrates that protection is given to vulnerable parts of the building such as areas exposed to high pedestrian traffic, vehicular and trolley movements	**1 credit is achieved**. Typical details were shown of design for robustness including door kick plates and vehicle barriers etc. It was agreed that these look adequate
MW13 Storage or Retailer Recyclable Waste		There is **1 credit available** in this section; can be awarded where evidence provided demonstrates that there are dedicated facilities for the separation and storage of retail generated recyclable waste materials	**1 credit is achieved**. It was confirmed that will provide adequate areas for the collection of materials from tenants for recycling - at least 6 separate bins for different materials. Drawing showing location and number of bins was produced. Evidence in the form of this drawing showing location of storage facility
MW16 Compactor/Baler	to recognize the provision of facilities that enables the efficient and hygienic operation of waste sorting and storage	There is **1 credit available** in this section; can be awarded where evidence provided demonstrates that either a compactor or baler is provided for compacting	**1 credit is achieved**. A drawing was produced showing location of compactor. This to be provided as evidence

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
LAND USE AND ECOLOGY CREDITS			
LE1 Re – use of Land	to encourage reuse of land that has been previously occupied by building developments and discourage the use of previously undeveloped land for building.	There is **1 credit available** in this section; it can be awarded as where evidence provided demonstrates that the footprint of the proposed development largely falls within the boundary of land previously developed	**1 credit is achieved**. The land was previously used for maintenance of vehicles and the storage of building materials. Evidence in the form of a letter stating this and it is believed that this should be adequate
LE3 Ecological Value of Land and Protection of Ecological Feature	to encourage development on land that already has limited value to wildlife and to protect existing ecological features from substantial damage during site preparation and completion of construction works	There is **1 credit available** in this section; it can be awarded as where evidence provided demonstrates that the construction zone is defined as land of low ecological value and all existing features of ecological value will be fully protected from damage during site preparation and construction works	**1 credit is achieved**. A photograph was produced showing that there were no trees or other features of ecological value on the site prior to development. Evidence in the form of a letter and this photograph
LE4 Impact on Site Ecology	to minimize the impact of the development on the site ecology and, where possible, enhance the ecological value of the site	There are **5 credits available** in this section; if the first credit is not achieved then no further LE4 credits may be awarded. First credit can be awarded as where a professional ecologist has been appointed to advised on the protection and enhancement of the site ecology. Additional credits: - One credit can be awarded where evidence provided demonstrates (having visited the site prior to any work being undertaking) that the change in the ecological value of the site, as a result of development, is less than zero and equal to, or greater than, minus nine species, i.e. a small negative change. This is	**1 credit is achieved**. An ecologist has been appointed but may not meet BREEAM requirements for professional qualifications. Ecologist did not visit site prior to building starting. This is a complex issue particularly as two credits have combined. It will discuss with BREEAM. Two credits have been awarded initially but there is a good possibility that the BREEAM will not permit this. Evidence in the form

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
LAND USE AND ECOLOGY CREDITS			
LE4 Impact on Site Ecology		to be calculated using the LE4 calculator. - Two credits can be awarded where evidence provided demonstrates that ther is no negative change in the ecological value of the site as a result of development, i.e. equal to, or greater than, zero species. - Three credits can be awarded where such evidence provided demonstrates that the ecological value of the site is as a result of development enhanced by at least 3 species - Four credits can be awarded where such evidence provided demonstrates that the ecological value of the site is as a result of development enhanced by at least 6 species	of a letter and the completion of the BREEAM Ecology form by the ecologist. A qualified ecologist might need to be commissioned to validate the form.
POLLUTION CREDITS			
P4 Insulant GWP	to reduce the potential for global warming from substances used in manufacture or composition of insulating materials	There is **1 credit available** in this section; it can be awarded as where evidence provided demonstrates that the specification of insulating materials avoids the use of substances with a global warming potential (GWP) of 5 or more in either manufacture or composition	**1 credit is achieved**. It was agreed that all insulants used for services or building will have a rated Global Warming Potential of 5 or less. Specifications for architectural, services, and acoustic insulation have been provided. - The architectural insulation is based on extruded polystyrene with a GWP of less then 5 specified. - The thermal insulation od ductwork is specified as mineral wool. This has a GWP less than 5

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
POLLUTION CREDITS			
P4 Insulant GWP			- The insulation of hot and cold pipe work and acoustic treatment of ductwork is to use Armaflex foam.This has a GWP less than 5
P6 NOx Emissions of Heating Source	to encourage the use of heating that minimize NOx emissions, and therefore reduces pollution of the local environment reduces pollution of the local environment	There are **3 credits available** in this section; one credit it can be awarded as where evidence provided demonstrates that the maximum dry NOx emissions from delivered space heating energy are less than or equal to 100 mg/kWh The other one credit it can be awarded as where evidence provided demonstrates that the maximum dry NOx emissions from delivered space heating energy are less than or equal to 70 mg/kWh. And the last one credit it can be awarded as where evidence provided demonstrates that the maximum dry NOx emissions from delivered space heating energy are less than or equal to 40 mg/kWh	**3 credit is achieved**. Calculations have been carried out as specified in the BREEAM guidance documents for this bespoke. This takes into account heating by the gas – fired CHP and the gas – fired boilers. This indicates that overall NOx emissions are approximately 25 mg / kWh
P8 Minimizing Watercourse Pollution	to reduce the potential for pollution to natural watercourses from surface water run – off from buildings and hand surfaces	There is **1 credit available** in this section; it can be awarded as where evidence provided demonstrates that on site treatment such as oil separators / interceptors or filtration have been specified for areas at risk from pollution, i.e. vehicle manoeuvring areas, car parks, waste disposal facilities, delivery facilities or plant areas	**1 credit is achieved**. Agreed that oil separators will be installed on storm water drainage from car parks and loading bays and roads

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
POLLUTION CREDITS			
P11 Renewable & Low Emission Energy	to reduce atmospheric pollution by encouraging locally generated renewable or low emission energy to supply a significant proportion of the building's energy demand	There are **3 credits available** in this section; one credit can be awarded as where evidence provided demonstrates that a feasibility study considering renewable and low energy has been carried out and the results implemented. Second credit can be awarded as where evidence provided demonstrates that the first credit has been achieved and 10% total energy demand for the building/development is supplied from local renewable, low energy, sources. And the third credit can be awarded as where evidence provided demonstrates that the first credit has been achieved and 15% total energy demand for the building/development is supplied from local renewable, low energy, sources.	**1 credit is achieved**. A study was undertaken to assess feasibility of low and zero carbon energy systems for this project. This considered PV, wind and aquifers for heating and cooling. This demonstrates that PV and Wind would not be feasible. For the Erzurum project the aquifer was found to be prohibited by local regulations. As an alternative, a gas - fired CHP has been installed. This is expected to achieve at least a 10% reduction in CO_2 emissions. Following telecom with BREEAM it was agreed that gas - fired CHP is not classified as a LZCS technology by the BREEAM. However, the first credit could be awarded on the basis that the study had been carried out
P13 Noise Attenuation	to reduce the likelihood of complaints of noise from occupants of nearby noise – sensitive buildings, such as homes, hospitals and schools	There is **1 credits available** in this section; it can be awarded as where evidence provided demonstrates that sources of noise from the development do not give rise to the likelihood of complaints from existing noise sensitive premises and amenity or wildlife areas that are within the locality of the site	**1 credit is achieved**. The shopping mall site is surrounded by existing main roads but there are some dwellings with a few hundred meters of the development. It has been agreed with the project team therefore that a noise survey will be carried out to ISO 1996. A letter has been provided by Redevco stating that such a noise survey is to be carried out and that any remedial works recommended will be implemented

Table A.1 : (continued) Detailed Achieved Credits of BREEAM 2006 Retail for Erzurum Shopping Center

Subheadings	Credit Aims	Way to Achieve	Credit Validation
POLLUTION CREDITS			
P14 Kitchen Wastewater Filtration	to prevent wastewater contaminated with liquid vegetable fat and grease being discharged to sewers, therefore reducing the loading of local sewage treatment facilities.	There is **1 credits available** in this section; it can be awarded as where evidence provided demonstrates that food oils are separated from wastewater prior to discharge to the local sewer	**1 credit is achieved**. It was agreed that oil separators will be installed on the waste pipes from all sinks in catering areas

CIRRICULUM VITAE

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Universities and Colleges attended :

Graduate School : Istanbul Technical University

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College : Yıldız Technical University,

(2000 – 2005) Faculty of Architecture, Department of Urban and Regional Planning

High School : Sakıp Sabancı Anatolian High School

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In 2005, working life of Meltem Turker has started as a consultant in real estate investments, Arthur&Miller Real Estate Head office, which is an Istanbul based company has over 10 offices around Turkey, and continued in both housing and commercial real estate transactions as a broker until starting her own firm GRED Global Real Estate Development in 2008, serving in consultancy and real estate valuation.